

SOFTWARE AND SERVICES MARKET

EUROPE 1992 - 1997

DISCRETE MANUFACTURING SECTOR

INPUT

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Information Services Programme—Europe
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***Software and Services Market, Europe,
1992-1997—Discrete Manufacturing Sector***

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Abstract

This report analyses the market for software and services in the European discrete manufacturing sector. It identifies the major issues and opportunities for vendors, together with the driving forces influencing the use of software and services in the discrete manufacturing sector. Market forecasts are provided for the major country markets—Germany, France, the United Kingdom and Italy—and by key delivery mode. The principal delivery modes are turnkey systems, industry-specific applications software products, professional services, systems integration, network services, systems operations and processing services. The leading vendors within each country market are identified. The principal issues facing vendors in the computer integrated manufacturing market are discussed. This report is an update to research published by INPUT in 1991.

This report contains 114 pages and 71 exhibits.

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I Introduction

A Objectives

The principal objectives of this report are:

- To forecast the size of the market for software and services in the discrete manufacturing sector for Europe and for each of the major country markets over the period 1992-1997.
- To forecast the size of the market for software and services in the discrete manufacturing sector by delivery mode.
- To identify the leading software and services vendors to the discrete manufacturing sector in each of the major country markets.
- To identify the major issues facing software and services vendors that target the discrete manufacturing sector.
- To identify the forces influencing the demand for software and services within the discrete manufacturing sector.
- To analyse the buying process and major opportunities within the computer-integrated manufacturing market.
- To identify the opportunities arising for software and services vendors in this sector over the period 1992-1997.

B Scope

This report analyses the market for software and services within the European discrete manufacturing sector over the period 1992-1997.

The discrete manufacturing sector is defined as:

- Manufacturing of metal article
- Mechanical engineering
- Electrical and electronic engineering
- Instrument engineering
- Manufacture of motor vehicles, their parts and other means of transport
- Textile industry
- Leather and leather goods manufacture
- Furniture manufacture
- Printing and publishing

Geographically, the report divides Europe into:

- Germany
- France
- United Kingdom
- Italy
- Rest of Europe

Market forecasts are derived from corporate user expenditures on software and services. Forecasts are provided over the period 1992-1997 for each of the key delivery modes, namely:

- Industry-specific applications software products
- Turnkey systems
- Professional services
- Systems integration
- Network services
- Processing services
- Systems operations

C

Report Structure

Chapter I provides details of the objectives and scope of the research.

Chapter II is the Executive Overview of the entire report. It summarises the principal findings of the research, with an emphasis on the opportunities for software and services vendors in the discrete manufacturing sector.

Chapter III contains an overview of the software and services market in the European discrete manufacturing sector, including a list of the leading software and services vendors and the key industry subsectors.

Chapter IV provides market forecasts broken down by delivery mode for Germany, France, United Kingdom and Italy. The leading vendors in each country are also identified.

Chapter V provides an analysis of the software and services market in the Western European discrete manufacturing sector broken down by delivery mode. For key delivery modes, further breakdowns of market size are supplied—for example, by equipment type and by application.

Chapter VI contains an analysis of the computer-integrated manufacturing market. It discusses the driving forces, the roles of the key players in the buying process, and the principal project types found in the discrete manufacturing sector.

Chapter VII discusses the principal challenges facing software and services vendors that target the discrete manufacturing sector and indicates some of the generic strategies being followed by vendors.

Chapter VIII provides an overview of the driving forces within the discrete manufacturing sector.

Chapter IX summarizes the conclusions and recommendations of the report, emphasising the opportunities available to software and services vendors.

II Executive Overview

A

Software and Services Spending Grows Despite Recession in Europe

Economic recession, defence budget cuts and restrained consumer spending restricted the growth in software and services in the discrete manufacturing sector across the whole of Europe in 1991.

Growth is forecast to be restricted to 12% between 1991 and 1992, which is approximately 4% less than forecast last year. For example, CAD/CAM sales volumes continued to rise quickly, but user spending on turnkey systems has fallen to 5% in real terms across Europe. Some of the hesitation in the flow of orders experienced by vendors in 1991 is expected to recover in 1992-1993.

Integration remains a key requirement among discrete manufacturers as they switch more and more to software package solutions. Discrete manufacturers are not just integrating the IT components of various systems, but integrating these systems with their manufacturing and business processes.

The trend towards adoption of downsized open systems is increasing pressure on traditional software applications suppliers to offer more portable software and provide suites of migration aids. Those vendors that cannot respond quickly enough are losing market share to new entrants in the package market. Larger, more comprehensive and complex solutions are starting to give way to smarter, smaller, more pragmatic, "good-fit" rather than "best-fit" solutions.

Demand for professional services is changing in nature. Contract staff were the first to be laid off when economic pressures forced cuts. Software development skills are less in demand than project management, business implementation, operations management and systems integration skills.

Germany is still the largest manufacturing market and the fastest growing major market for software and services. But real growth (excluding inflation) is falling to around 13% per year as the country comes to terms with absorbing East Germany and countering the worldwide recession. (All other growth rates in this report include inflation estimates.)

Pressures for cost reduction have reached the information systems department, as well as the factory floor. In France and the United Kingdom, this trend will lead to significant growth in the usage of systems operations. Some discrete manufacturing companies are outsourcing their computer operations activities to achieve reductions in running costs. Other companies are downsizing their equipment, which can lead to transition management opportunities for systems operations vendors.

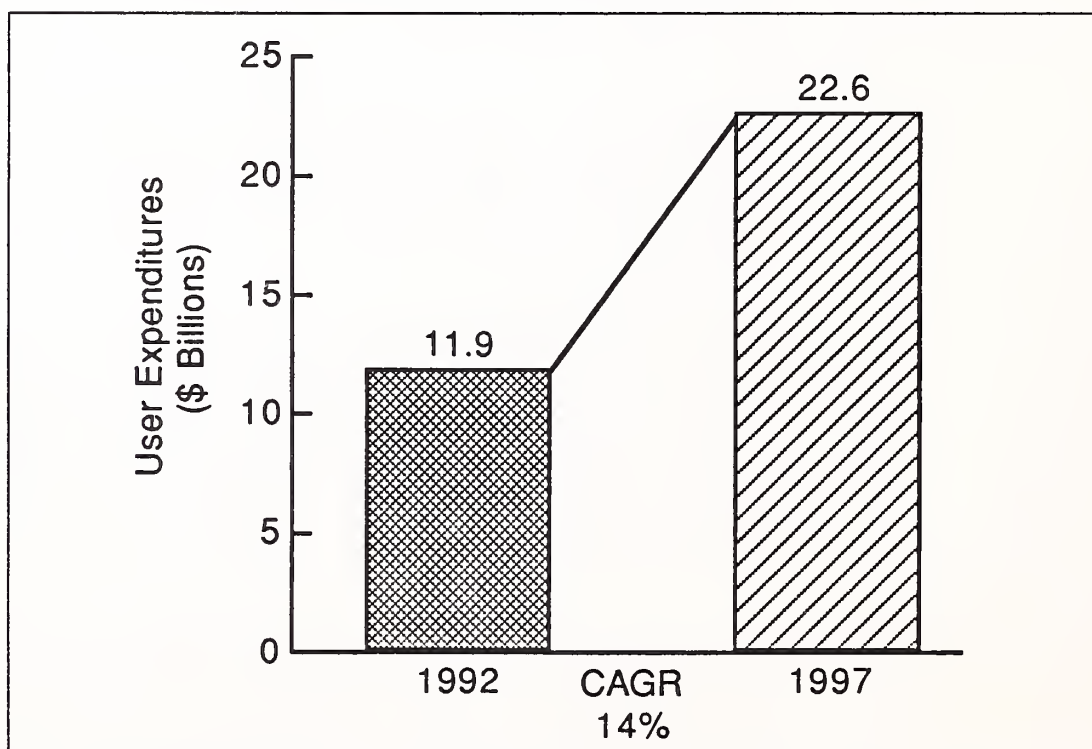
B

Country Markets

INPUT forecasts that the market for software and services within the discrete manufacturing sector will be worth \$23 billion in 1997. The CAGR will be 14% over the forecast period, as shown in Exhibit II-1.

EXHIBIT II-1

Software and Services Market Forecast Discrete Manufacturing Sector, Europe

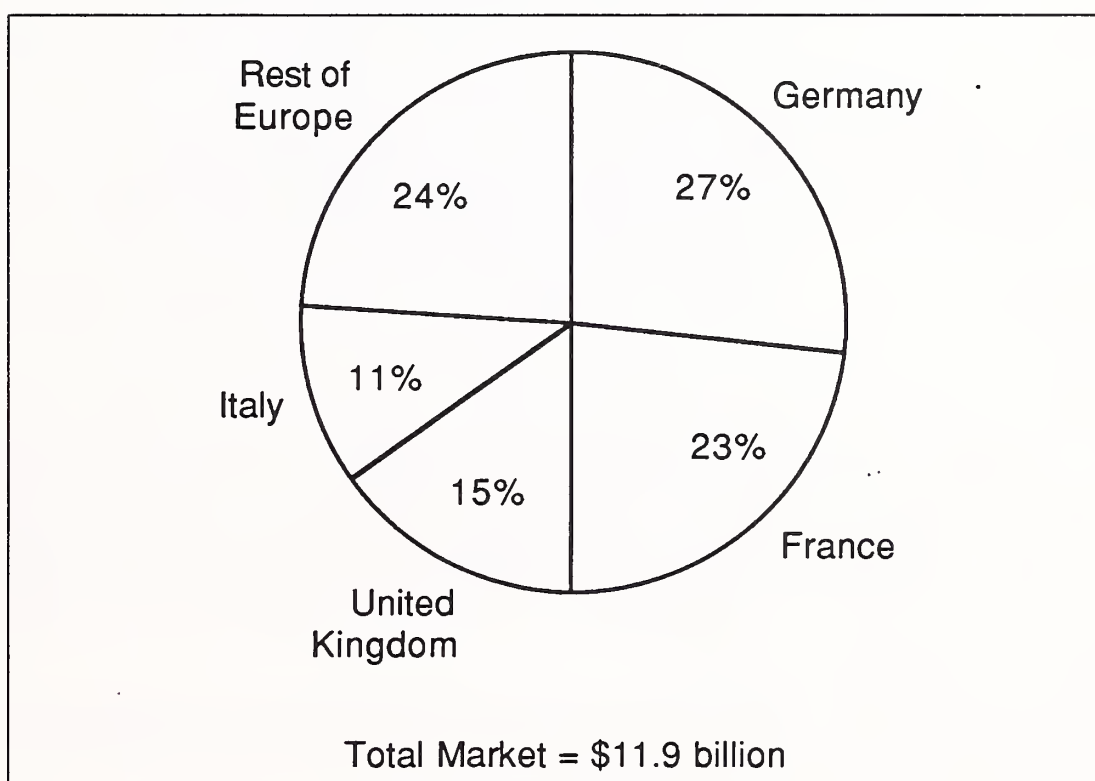


This growth rate for the whole of the software and services market obviously shows considerable variation from country to country and between delivery modes. For example, because of the increasing need to integrate applications already implemented—such as CAD and production management—the growth in systems integration will be significantly greater over the next few years than that in turnkey systems and software products. Exhibit II-2 shows the 1991 European software and services market distribution by country.

Amongst the four major Western European countries, Germany is forecast to have the highest growth rate, a compound annual average growth rate of 17% over the period 1992-1997.

EXHIBIT II-2

**Software and Services Market Forecast
Percentage Distribution by Country, 1992
Discrete Manufacturing Sector, Europe**



Germany has been recognised for some time as having the strongest manufacturing base in Western Europe, and additional investment within the discrete manufacturing sector is being fuelled by the impact of reunification with East Germany.

In addition, Germany's quality car manufacturers are, for the first time, being threatened by the Japanese. As the Japanese move their product ranges into the luxury car market, German manufacturers will have to change their production processes in order to bring their production costs into line. This change presents opportunities for software and services vendors.

At the other end of the spectrum is the discrete manufacturing sector in the U.K., with a forecast compound annual average growth rate of 10%. This sector in the U.K. is currently depressed by high interest rates, and many companies in the discrete manufacturing sector are delaying the implementation of information systems projects. This state of affairs is expected to continue for some time. However, these cost reduction pressures on the U.K. discrete manufacturing sector provide some opportunities. For example, as companies reduce the cost of their in-house IS departments, the need for professional services and systems operations vendors increases.

Growth rates for software and services within the discrete manufacturing sector in France and Italy lie between those of Germany and the U.K., at 11% and 15% respectively. Although vendor attitudes towards the strength of the markets in Germany and the U.K. showed a high level of consistency, their views of the future prospects for the software and services market in France and Italy were mixed. Some vendors in France were anticipating high levels of growth, while others were increasingly fearful of a further slowdown as the defence and automotive sectors continue to suffer cuts. In 1992, the German economy is also feeling the effects of the recession in a number of its key export markets.

Italy remains a difficult market for non-indigenous vendors, but one in which many vendors would like to increase their presence, as illustrated by the recent purchase of a 60% stake in Mesarteam by Sligos. Part of the difficulty lies in the nature of Italian accounting practices. Another factor is that the market lacks sophistication, with many manufacturers only requiring low levels of functionality in their production management systems.

The major subsectors within the European discrete manufacturing sector are:

- Automotive
- Electrical and electronic
- Mechanical engineering

These subsectors, together with aerospace, tend to be the subsectors most heavily targeted by software and services vendors. Expectations from aerospace and the automotive sector have decreased dramatically since 1990 following poor sales in 1991.

The automotive sector is the traditional leader in the use of process technology to lower production costs. In recent years, lowering of production costs has frequently taken the form of increased technological modernisation of production facilities, leading to very high levels of factory automation and significant opportunities for software and services vendors. Automotive manufacturers in Western Europe are again facing considerable pressures to improve their performance or face the prospects of acquisition and rationalisation. In addition, considerable capital expenditure is being made by vehicle manufacturers in Eastern Europe. Both these factors are likely to lead to increased expenditure on product and process technology, with the implied spin-offs for software and services vendors.

The aerospace sector has seen severe cutbacks as defence prospects have been cut or threatened. Aerospace has been the traditional leader in product technology and the use of CAD and computer-aided engineering (CAE) for prototype design and evaluation. Although product technology is still crucial in this sector, the use of sophisticated process technologies to help reduce production costs is becoming more important as competition increases. With their strong emphasis on design, the large aerospace companies will be important early adopters of engineering data management.

The electronics sector is another industry with a tradition of innovation, and the automotive, aerospace and electronics industries will remain at the forefront in the use of information technology despite recessionary effects.

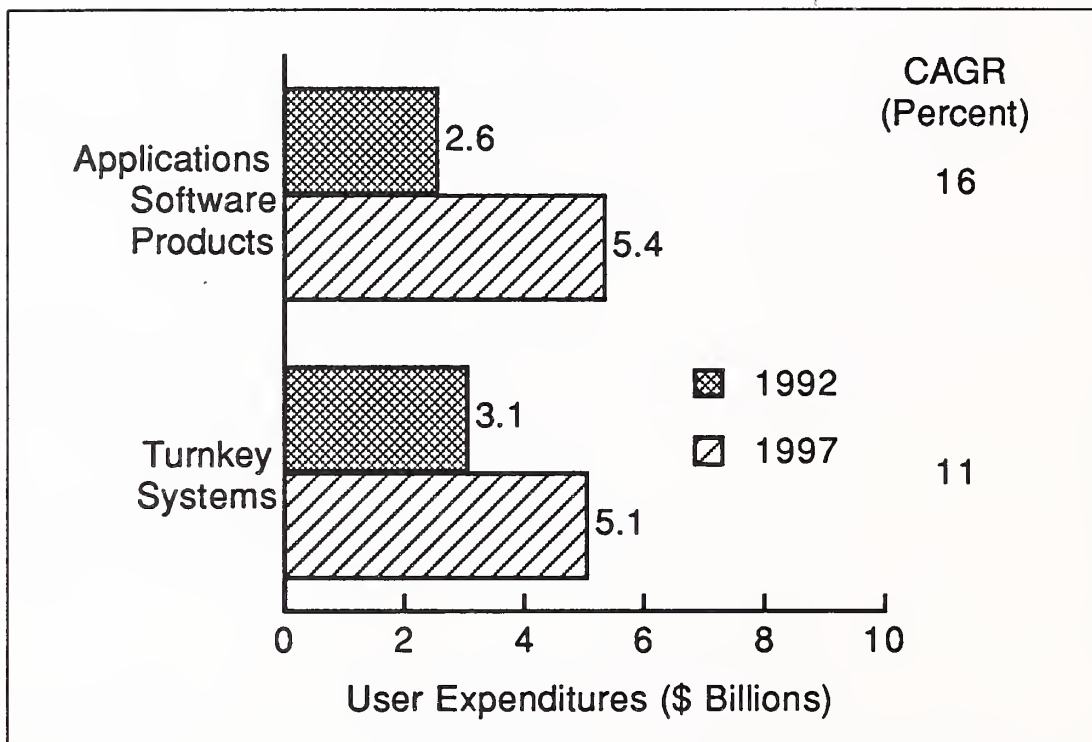
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Applications Software Products and Turnkey Systems

Turnkey systems was the largest single delivery mode in the European discrete manufacturing sector in 1991. However, this delivery mode is forecast to grow comparatively slowly over the period 1992-1997, along with the professional services delivery mode. Growth for applications software products and turnkey systems is shown in Exhibit II-3.

EXHIBIT II-3

Applications Software Products and Turnkey Systems Market Forecast, 1992-1997 Discrete Manufacturing Sector, Europe



Historically, major turnkey markets in the discrete manufacturing sector have been for applications such as CAD and production management. However, growth in both of these areas has slowed.

CAD/CAM was still a growing market in 1991, though the outlook is not good for growth in 1992. At the workstation level, the cost per seat will continue to fall. To counter these trends, the traditional CAD vendors such as IBM, Intergraph, and Computervision have introduced microcomputer-based products and are endeavouring to increase the use of CAD within discrete manufacturing organisations. In particular, vendors are keen to develop CAD from a drafting tool into a means of handling prototype evaluation and technical documentation. Adoption of concurrent engineering techniques is seen as a key driver of CAD workstation sales.

Both the turnkey systems and software product delivery modes are impacted by the slowdown in sales of production management systems. Production management is becoming largely a replacement market, and although the AS/400 segment has been healthy, there are signs of a slowdown in the Digital sector.

The increasing acceptance of UNIX forms a watershed for many of the traditional vendors of production management systems. Both applications

software product vendors and the traditional European minicomputer turnkey vendors are having to redevelop their packages in order to run under UNIX. Vendors are then faced with the task of persuading their existing customer base to remain loyal to them rather than choosing one of the many alternative UNIX-based competitors. For these reasons, branding of applications software products will increase in importance.

In 1990, engineering data management appeared to be a product in search of a market, but there are now signs of its adoption by the larger organizations in the aerospace and automotive sectors. Engineering data management is being actively promoted by the major equipment vendors—such as IBM, Digital and Unisys—and the specialist CAD vendors—such as Intergraph. Although current demand is low, the market for engineering data management systems is forecast to grow significantly over the next few years. Engineering database management is an important inter-application control mechanism that ensures that the appropriate data and the correct version of data are available to all authorised users.

Shopfloor data collection and control (SFDCC) remains a high-growth application on both minicomputers and microcomputers. Once production management systems are in place, one of the next priorities is to obtain up-to-date information regarding actual events on the shopfloor. SFDCC is the means of achieving this information. In its less sophisticated forms, SFDCC may involve solely manual input from shopfloor personnel. In its more advanced forms, SFDCC may involve direct control and monitoring of production cells. SFDCC is increasingly being used to monitor quality via techniques—such as statistical process control—and to monitor the availability of machinery and its maintenance requirements, as well as enabling the status of jobs in progress to be accurately assessed.

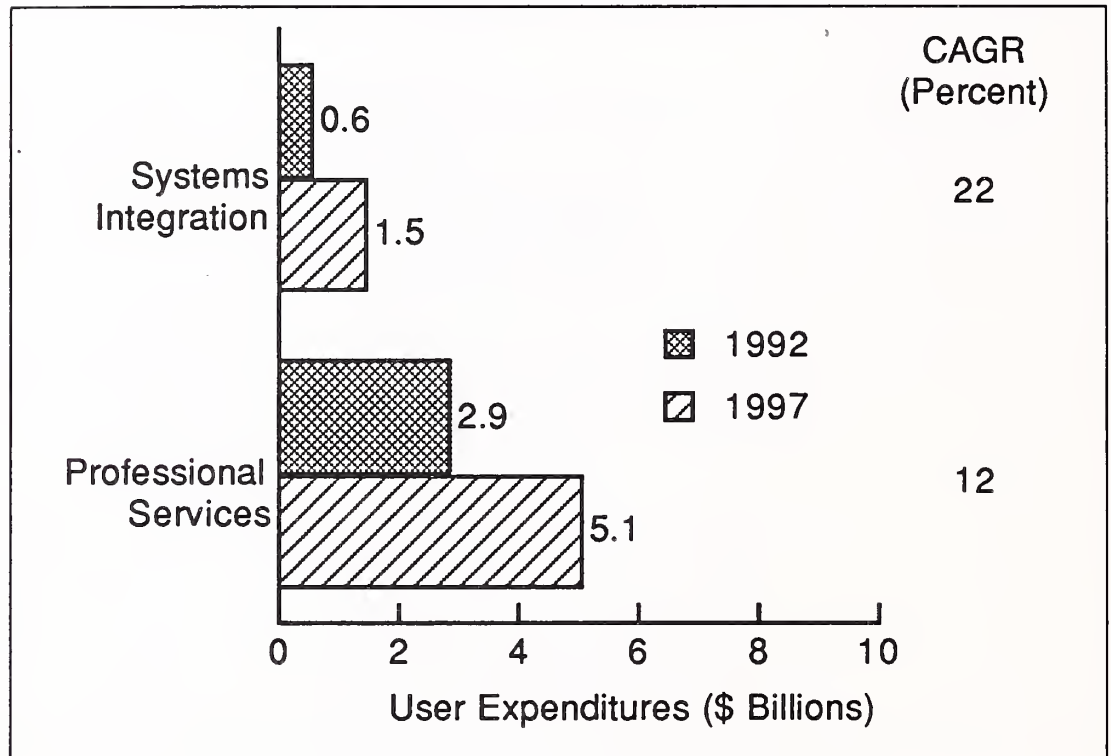
D

Systems Integration and Professional Services

Professional services revenues from the discrete manufacturing sector are forecast to grow strongly between 1992 and 1997, making professional services the dominant delivery mode during the course of the forecast period. Expenditures and growth for systems integration and professional services are shown in Exhibit II-4.

EXHIBIT II-4

Systems Integration and Professional Services Market Forecast, 1992-1997 Discrete Manufacturing Sector, Europe



A number of forces inhibit growth in professional services. Firstly, increasing cost pressure on the discrete manufacturing sector is being felt by information systems departments, which leads not only to reduction of personnel but also to cuts in contract staff. Secondly, the larger discrete manufacturing companies have now typically installed CAD, and probably several generations of production management systems, and are turning their attention to better integrated systems that cover the whole manufacturing process, from CAD to factory automation. Less application development work is only partially countered by more integration for service vendors.

In many areas, companies will retain their existing applications, but look to pass data amongst them. This will typically involve a certain amount of professional services activity, although application enablers supplied by equipment vendors such as IBM and Unisys may be used to provide the framework for integration. For example, IBM Plant Floor Series Plantworks provides systems and application enablers to support development of a customised distributed factory floor supervisory and control system. Similarly, Product Manager is an application enabler that assists in the management of engineering data and links to the production management system.

This evolutionary approach is not always being adopted. In some instances, users are reviewing their complete systems strategy and are replacing all existing applications in a drive towards a complete business solution. One example of this approach is Thorn-EMI, which has standardised its systems across nine operating divisions.

Another example of a company taking the computer-integrated manufacturing route is Kennametal Erickson, a cutting tool manufacturer currently spending \$10 million on CIM across Europe.

Ideally in a CIM environment, all applications would present a common interface to users. This environment has been achieved by Gebr Heller Maschinenfabrik, working in conjunction with SNI, and is being moved towards by a number of vendors.

INPUT's user survey revealed a very high level of interest amongst respondents in integrating the following:

- CAD and production management
- Production management and the shopfloor.

User integration plans are shown in Exhibit II-5.

EXHIBIT II-5

User Integration Plans

Area of Integration	Level of Requirement
CAD and production management	Very High
Production management and shopfloor	Very High

One example of a user in the process of linking CAD and production management is Rolls-Royce. Rolls-Royce has separately installed the Intergraph CAD system and the production management system from Computer Associates. The company has now linked production management to the Supercapes computer-aided production planning system and is planning to link Supercapes to the CAD system.

Applications software product vendors are generally not concerned with integration on a grand scale. However, they do tend to steadily increase the scope of their offerings. For example, production management software product vendors are evolving their offerings to cover more of the

distribution management function and to extend down into basic shopfloor data collection and control.

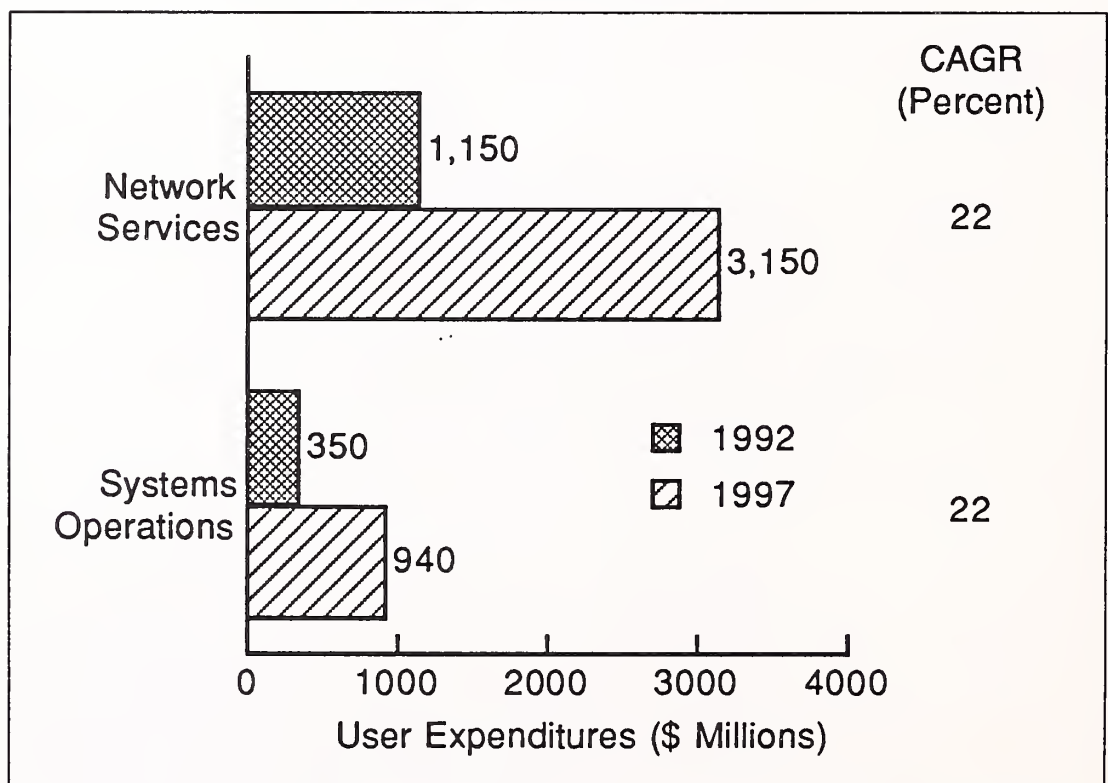
Applications software product vendors are also increasingly forming consortia amongst themselves to offer users a wide range of complementary applications. As these relationships become more established, it is likely that groups of integrated applications will begin to emerge. This type of development might also be initiated by professional services vendors, which see themselves taking overall project management responsibility.

E Network Services and Systems Operations

Use of network services and systems operations is forecast to grow rapidly over the period 1992-1997, as shown in Exhibit II-6.

EXHIBIT II-6

Network Services and Systems Operations Market Forecast Discrete Manufacturing Sector, Europe



Usage of EDI is widespread amongst major discrete manufacturing organisations, but both the scope and extent of this usage have been quite limited. Hence, there is considerable potential for EDI usage for

commercial purposes to expand significantly within the discrete manufacturing sector as the number of trading partners interconnected increases and as EDI is used for a wider range of transaction types.

The growth in systems operations will be fuelled by the increasing pressures on information systems departments to reduce their costs and concern about the value-for-money being achieved from in-house information systems departments. To achieve cost reduction, some discrete manufacturing companies are outsourcing their computer operations activities, which enables the companies to achieve a reduction in running costs of typically 20%-30% and a stable cost base. Other companies are downsizing their equipment, and this downsizing can lead to transition management opportunities for systems operations vendors. Systems operations is already important in the United Kingdom for vendors such as Data Sciences and Hoskyns, while a large part of AT&T Istel's revenues come from their systems operations activities on behalf of the Rover Group.

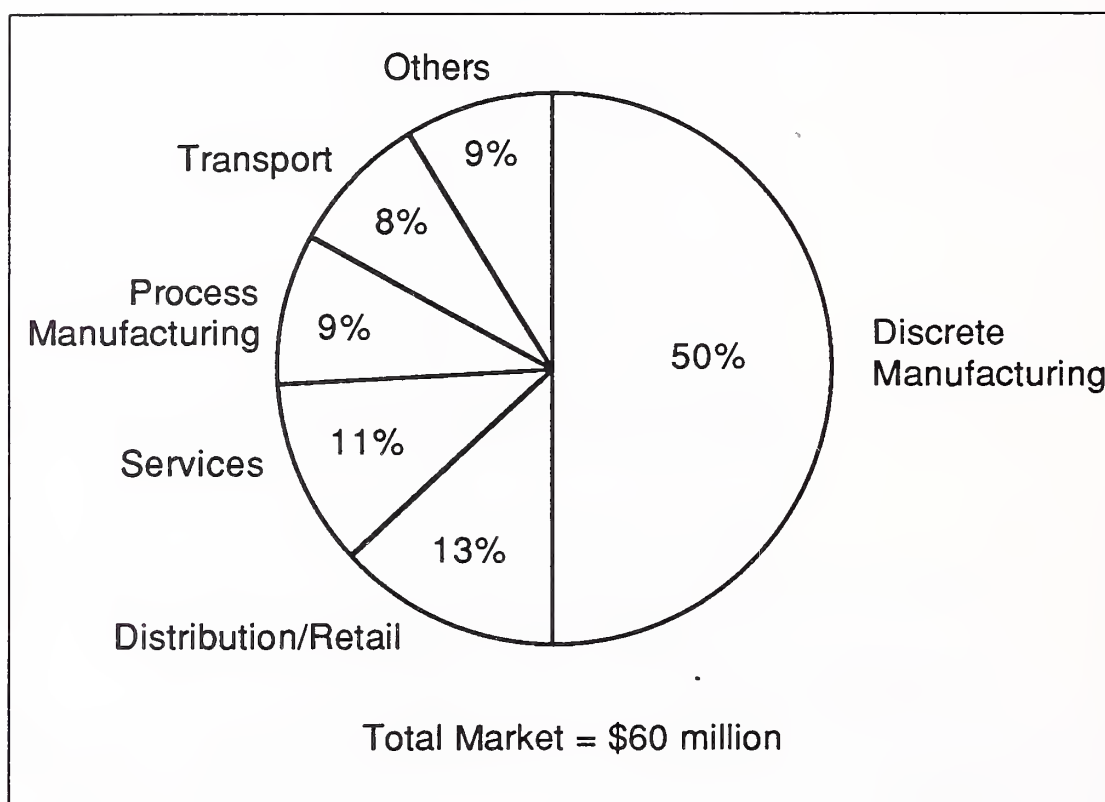
Systems operations will become important within the discrete manufacturing sector in France. However, it is possible that initially there will be a faster take up of systems operations by multinationals operating in France than by French discrete manufacturing companies.

As Exhibit II-7 shows, the discrete manufacturing industry is the leading sector in the use of EDI. While much of this demand is driven by increasing use of just-in-time techniques, there is also considerable interest in the exchange of CAD data within the European discrete manufacturing sector. This interest is fuelled by the closer links being forged between manufacturers and suppliers. For example, in the automotive sector, component manufacturers are becoming involved with the manufacturers as partners in vehicle design. Accordingly, a strong need exists to exchange up-to-date CAD data. To date, this exchange has been largely achieved by the use of the same brand of CAD software and the exchange of magnetic tapes. However, networked exchange of data would enable much better communication between the relevant parties. This is also true for the exchange of data between the various sites and departments of individual manufacturing companies.

In the automotive sector, work is being undertaken to establish standards for the exchange for design data.

EXHIBIT II-7

EDI Market by Vertical Sector Europe, 1991



F

User Pressures

Many of the larger discrete manufacturing organisations are endeavouring to establish dominant positions within their chosen sectors of discrete manufacturing industry. In many cases, organisations have involved acquisitions to build European market share and to establish credibility at a European level. Rationalisation of facilities may follow, which has its own implications for software and services vendors as standardisation across countries occurs and buying decisions are no longer made at the individual subsidiary level.

Having built their European framework, discrete manufacturers are still facing cost pressures that pose a significant threat to their long-term competitiveness. For example, a recent study concluded that it took European manufacturers double the labour input to assemble a car, compared to their Japanese competitors.

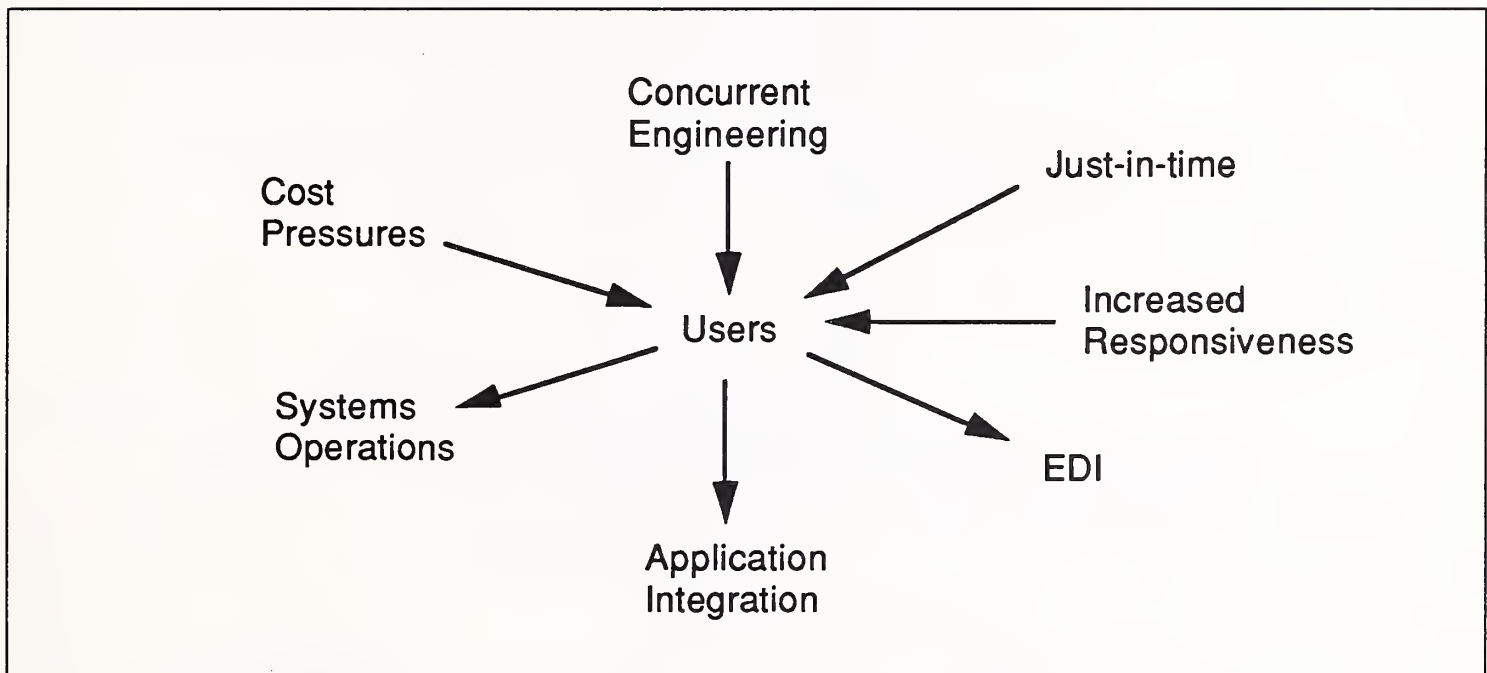
The same broad conclusions are true at the design stage, where European manufacturers require double the engineering effort to develop a car. As well as the cost implications, the rate of new product introduction is

increasing all the time, and manufacturers should be trying to significantly reduce the time it takes to bring a product to market.

In addition to all these issues, customers are expecting greater product variability and reduced delivery times. A summary of these user pressures is shown in Exhibit II-8.

EXHIBIT II-8

User Pressures



Each of these issues presents an opportunity for software and services vendors. Concurrent engineering necessitates more widespread use of CAD, and greater levels of integration with production engineering (via computer-aided process planning and computer-aided engineering), and production management systems.

Similarly, increased levels of integration between the shopfloor, the production management systems and the design systems lead to tighter control of manufacturing facilities, with resulting increased responsiveness to customers. Both cost reduction and improved delivery times can be achieved using just-in-time techniques, which are themselves greatly facilitated by use of EDI.

G

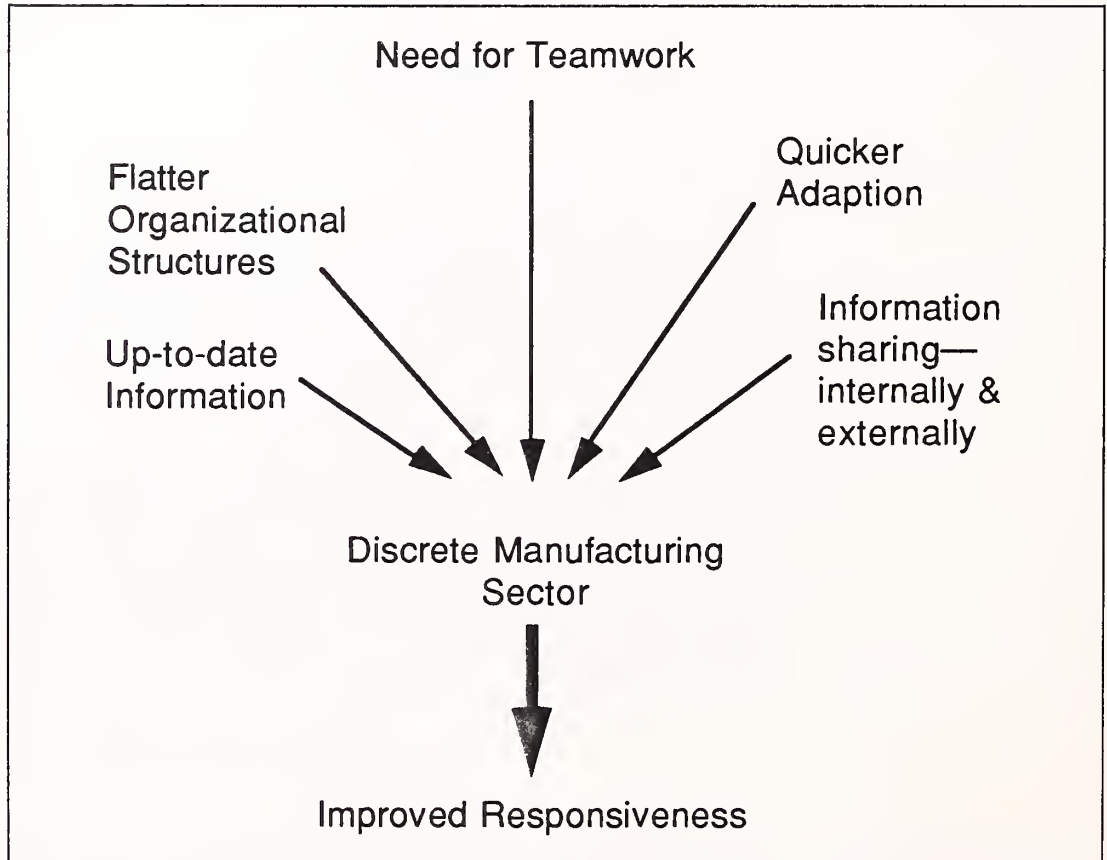
Computer-Integrated Manufacturing

Exhibit II-9 indicates the driving forces encouraging companies to evolve towards computer-integrated manufacturing. Discrete manufacturing companies recognise the need for increased responsiveness to their clients, and that the success of Japanese companies has been achieved by better teamwork and facilitating staff throughout the organization in contributing towards product and process improvements.

CIM can make a major contribution in these areas by providing up-to-date information on design details and production status, and by facilitating the sharing of such information across the organization.

The fastest growing subsectors in the adoption of CIM by the discrete manufacturing sector are the aerospace, automotive and electronic engineering subsectors.

EXHIBIT II-9

**Driving Forces, Computer-Integrated Manufacturing
Discrete Manufacturing Sector, Europe**

CIM has the potential to make a major impact on the user's business performance, provided that CIM is implemented to support the organization's unique business strategy in the short- and long-term. Because of this and the need for strong cross-departmental coordination in approaching CIM projects, user top managements are key players in the buying process, as indicated in Exhibit II-10.

To succeed in the CIM market, vendors need to build good relationships with user top management and be able to assist them in evaluating business issues. Accordingly, vendor account managers play an important role in developing CIM business. Equipment vendors especially recognise that only their more senior staff have the skills to discuss business issues on an equal footing with user top management.

Collaboration partners are of less significance to equipment vendors in terms of lead generation, although some vendors are asked to act as prime contractors by their partners. The professional services vendors typically lack the calibre of account management exhibited by the equipment vendors and are more dependent on their partners, especially the equipment vendors.

EXHIBIT II-10

Key Players in Buying Process Computer-Integrated Manufacturing, Europe

- User top management
- Vendor account managers
- Collaboration partners

The main types of projects encountered by vendors are listed in Exhibit II-11. The most common type of project is linking the shopfloor to the production management system. The main objectives behind this are the collection of up-to-date information to assist in managing throughput and the support of total quality management and just-in-time techniques. At present, less emphasis is on direct control of shopfloor equipment. Supply chain integration is becoming very important, with a resulting emphasis on product tracking and improved communication with clients and suppliers.

The integration of CAD with production management systems via computer-aided process planning or engineering data management shows a lower level of activity than shopfloor integration. However, integration is now occurring in the aerospace sector, with the electronics and automotive sectors likely followers.

Computer-integrated manufacturing has traditionally only been a feasible goal for the larger manufacturer. However, the requirements imposed by some of these companies on their small suppliers—such as just-in-time deliveries and quality procedures—are encouraging these smaller companies to move towards a more integrated environment.

Although application enablers may be the most appropriate route for large manufacturers to take towards integration, applications software products are more appropriate for the smaller organization.

EXHIBIT II-11

Principal Project Types Computer-Integrated Manufacturing, Europe

Project Type	Frequency of Occurrence
Linking production management to shopfloor systems	High
Engineering data management	Medium
Linking CAD/CAE to production management	Medium
Shopfloor equipment control	Low-Medium

Exhibit II-12 lists some of the major issues vendors face in addressing computer-integrated manufacturing. Firstly, getting access to the key decision makers in user top management needs to be addressed. Business consulting is increasingly the catalyst for CIM projects and some of the equipment vendors have been endeavouring to use their own experts as business consultants. Business consultancy is a traditional weakness for the professional services vendors. The management consultancies are in a strong position to generate CIM business, and in recognition of this, a number of vendors—for example, IBM and CGS—have been acquiring or forming joint ventures with these organisations.

When addressing the CIM market, the ability to offer a coherent CIM architecture is a major selling tool. Vendors must demonstrate to the user that any applications implemented or projects carried out are compatible in the long-term with full integration of systems. Accordingly, IBM has developed ICA (IBM CIM Architecture) supported by a number of enabling

products, while Digital relies on NAS (Network Application Support). Data management across applications is very important.

There is also a strong trend towards use of open systems. At present, this trend is predominantly found at the shopfloor level for applications such as shopfloor data collection and control. However, the eventual move to distributed production management systems will likely see extensive use of open systems.

EXHIBIT II-12

Vendor Issues Computer-Integrated Manufacturing, Europe

- Access to key decision makers
- CIM architecture
- Open systems
- Providing building blocks
- Degree of independence

Partnerships between vendors are very important in the CIM market. Firstly, partnerships provide many vendors with access to sales leads typically from the management consultancies and equipment vendors.

Secondly, applications software products are essential building blocks for the implementation of CIM, and vendors need access to a comprehensive range of products. Two radically different approaches are open to vendors. One option, typically adopted by IBM, for example, is to select a single applications software product for each equipment/application combination and market it strongly. Equity participation is often used to strengthen the ties between partners and maintain the exclusivity of the partnership.

The other alternative, adopted by Digital and CGS, is to form a number of loose partnerships with competing applications software product vendors. These loose partnerships make it easier for the prime contractor to maintain the appearance of independence and to select the most appropriate combination of applications for each situation.

As well as applications software products, many equipment vendors need access to third-party implementation and software development skills.

IBM's authorized industrial systems integrator programme is a means of developing closer relationships with suitable partners for this purpose.

Overall, the equipment vendors are well-positioned to target the CIM market with strong account management and credible CIM architectures. However, they lack business consulting and software development skills.

The professional services vendors are typically—though with some exceptions—less well-positioned to target the CIM market, since they lack formal CIM architectures and have less-capable account management, in addition to typically lacking business consulting skills. However, professional services vendors are extremely well-positioned to support the equipment vendors by providing many of the implementation and development services that the equipment vendors lack the resources to carry out.

H

The Need for Collaboration

The major issue facing software and services vendors targeting the discrete manufacturing sector is the need for collaboration. Some examples of vendor collaboration are given in Exhibit II-13.

EXHIBIT II-13

Vendor Issues: Collaboration

- IBM-approved industrial systems integrators
- Cincom "CIM alliance" programme
- Siemens and Lucas E & S
- Sligos and Mesarteam

One aspect of this collaboration is the need for software and services vendors to achieve European coverage, given the increasingly European focus of their clients. This coverage has been readily achieved by the major CAD vendors—such as Intergraph and Prime/Computervision—but is proving more difficult for vendors to achieve in commercial areas—such as production management systems. At present, there are no pan-European MRPII suppliers apart from equipment vendors such as IBM, although SAP is starting to develop a significant base outside Germany.

The other aspect of the collaboration issue is the need to provide complete business solutions for clients. Discrete manufacturing companies are increasingly looking to move towards a computer-integrated manufacturing environment. This move places a considerable stress on vendors to provide a wide range of software and services.

At present, it is impossible for any single vendor to provide such a wide range of offerings, and so extensive collaboration programmes are being built up by vendors.

The major equipment vendors—such as IBM, DEC and Siemens—are endeavouring to provide complete computer-integrated manufacturing environments for their clients and are endeavouring to become major systems integrators in their own right. As always, they have a strong need for applications software products that can be marketed on their equipment. Nor have they yet assembled teams with adequate depth and breadth of experience to handle all aspects of systems integration. As a result, the major manufacturers remain dependent on the professional services vendors to carry out specialised work on their behalf. IBM's Approved Systems Integrator programme is an example of this need, as is Siemens's relationship with Lucas.

Professional services vendors are faced with the question of whether to become owners or exclusive distributors of applications software products, or whether to depend almost exclusively on more informal partnerships with applications software product vendors. Opinion is divided on this subject, but either way, professional services vendors will always have some need for complementary applications software products to fill the gaps in their own product range.

Rather than let professional services vendors preempt the situation, applications software product vendors are forming their own consortia. For example, Cincom's CIM Alliance programme enables the company to offer users a wide range of complementary products alongside its own production management system.

I

Vendor Approaches to the Discrete Manufacturing Sector

Exhibit II-14 lists the leading vendors of software and services to the discrete manufacturing sector.

EXHIBIT II-14

Leading Vendors, 1991 Discrete Manufacturing Sector, Europe

Vendor	Estimated Revenues (\$ Millions)	Market Share (percent)
IBM	495	4.5
CGS	380	3.4
SNI	300	2.7
Intergraph	260	2.3
Computervision	210	1.9

IBM has been particularly active in terms of product announcements for the discrete manufacturing sector over the last two years, following the announcement in October 1989 of the IBM CIM Architecture (ICA). IBM says ICA provides a framework for integrating CIM information from multiple applications and information systems supplied by multiple vendors. ICA is clearly an attempt by IBM to persuade users to move towards computer-integrated manufacturing within an IBM framework, whilst reassuring them that non-IBM solutions can be included in part.

The architecture defines a set of hardware and software interfaces, together with a method for defining, managing and controlling CIM data. To address the two key areas of integration, IBM offers two enablers: Product Manager and Plant Floor Series. Product Manager helps manage engineering data and its release to production management. The Plant Floor Series supports the development and integration of distributed factory floor supervisory and control systems.

The overall emphasis of these IBM offerings is to encourage users to retain their existing IBM products and to move towards a more complete CIM environment. However, at the same time IBM is turning considerable attention towards its intermediate CIM offerings, which are based around the AS/400 and RS/6000.

A summary of vendor strategies is given in Exhibit II-15.

EXHIBIT II-15

Vendor Strategies

- Major equipment vendors and professional services vendors battle for systems integration market
- Applications software products vendors move towards UNIX
- IBM seeks to impose CIM architecture
- Partnerships versus product ownership

Siemens-Nixdorf, aided by Siemens Automation (the company's factory automation business), is also aggressively targeting full computer-integrated manufacturing solutions.

CGS is undoubtedly the most successful professional services vendor in Europe's discrete manufacturing sector, and its leadership position has been further emphasised by the acquisition of Hoskyns. CGS has established itself in each of the four major country markets ahead of its rivals, such as Sligos and Sema Group. CGS's current emphasis is on developing its business consultancy activities to enhance its access to user top management via the Gemini Consulting arm of Sogeti.

One of the key strategic question for professional services vendors is the issue of partnerships versus product ownership. There are two points of view on this question. One is that applications software products are an essential entry point into the professional services and systems integration markets. The opposing view is that products are expensive to develop, and it is better to build up a range of partnerships, giving access to the leading applications software products.

At the moment, the trend seems to be towards increasing polarisation of applications software product vendors and professional services vendors, with the latter becoming project managers and integrators. This approach increases the flexibility of professional services vendors at a time when considerable research and development is being spent on software products to implement them in a UNIX environment. The trend may reverse itself when the leading software products under UNIX become clear, thus leading to increased merger activity.

Considerable sums are being spent by applications software product vendors, which have traditionally based their products on IBM mainframe

or Digital hardware in moving their products to AS/400 and UNIX environments. For example, Dun & Bradstreet and Xerox have moved their production management systems onto the AS/400, while CINCOM and ASK are introducing UNIX versions.

J

Key Opportunities

The major trend in the discrete manufacturing sector is users' need to integrate the major applications already installed—such as CAD and production management—and to provide better control of, and feedback from, activities on the shopfloor. In addition to providing better control of factory activities, and hence higher levels of customer responsiveness, the sharing of common up-to-date information between departments leads to considerable improvements in intraorganisation communication and concurrent working. For example, improved sharing of data is forecast to lead to considerably reduced lead times in product design and to more reliable products. This need for integration presents opportunities for both professional services and systems integration vendors.

As well as intraorganisational integration, closer links are being established between manufacturers and their suppliers. As collaboration between manufacturers and their suppliers grows, and as just-in-time procedures become more commonplace, the use of EDI can be expected to expand significantly. At present, use of EDI is being delayed by the lack of standards that can be applied on a global basis.

Information systems departments within the discrete manufacturing sector are coming under cost pressures, with some layoffs taking place as a result. This is leading to increased opportunities for professional services vendors and systems operations vendors. As yet, no single software and services vendor can provide the wide range of products and services required by the discrete manufacturing sector. This is leading to widespread partnerships involving consortia of leading vendors and presents opportunities for vendors with a unique product or skill to take advantage of the marketing muscle of the principal vendors in the marketplace.

However, the grouping together of leading vendors with complementary skills may substantially limit the opportunities available to vendors that are excluded from these partnerships. The key opportunities are shown in Exhibit II-16.

The specific applications software product opportunities in the European discrete manufacturing sector are shown in Exhibit II -17.

EXHIBIT II-16

**Conclusions
Key Opportunities**

- Integration of major application areas
- EDI in support of JIT
- Cost reduction through professional services and systems operations
- Software products facilitating integration of "islands of automation"
- Partnerships essential

EXHIBIT II-17

**Conclusions
Applications Software Product Opportunities**

- MRPII replacement on Pan-European basis
- Shopfloor data capture and control
- Engineering data management
- Completion of "CIM Wheel"

Although the production management software product market has now largely become a replacement market, it still accounts for a sizeable proportion of total revenues from the discrete manufacturing sector, and a number of major changes are taking place in the market. Firstly, users are looking to adopt common MRPII systems for use throughout their European facilities. As there are no truly pan-European vendors in this area, this represents an open opportunity. The company closest to being a pan-European vendor is probably SAP. ASK and CINCOM have been successful in the United Kingdom and France, but have had difficulty in penetrating the German and Italian markets.

High growth rates are also forecast for shopfloor data collection and control, and engineering data management, both key areas in establishing a

CIM environment. Similarly, there are opportunities for products such as finite scheduling and computer-aided process planning, which assist in moving the user closer to a CIM environment.

III

European Software and Services Overview

A

European Overview

As shown in Exhibit III-1, the overall market for software and services within the European discrete manufacturing sector is forecast to grow from \$11.9 billion in 1992 to \$22.6 billion in 1997, a compound average annual growth rate of 14%.

These figures include only user industry-specific revenues, which means that revenues for systems software and cross-industry applications, such as accounting, are excluded. Examples of applications for which revenues are included are production management (including manufacturing resource planning or MRPII), and computer-aided design (CAD).

EXHIBIT III-1

Software and Services Market Forecast Discrete Manufacturing Sector, Europe

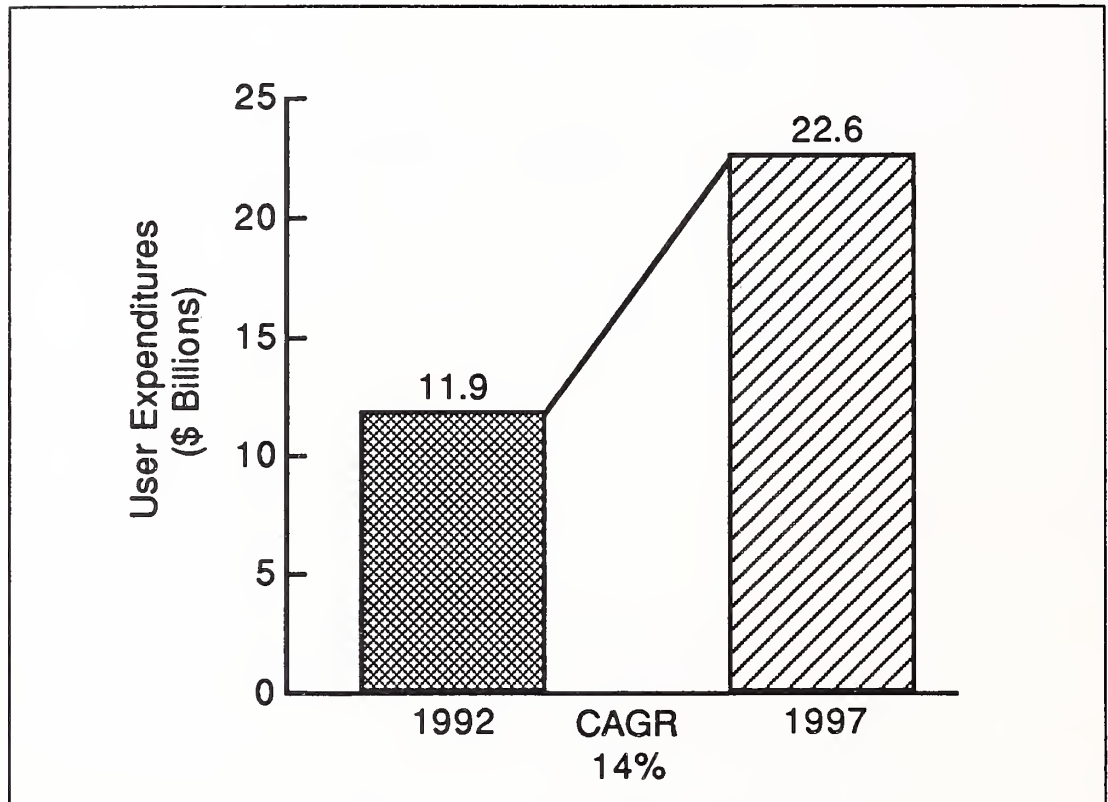


Exhibit III -2 shows the leading vendors in the discrete manufacturing sector, their estimated industry-specific revenues and their market share.

The list is dominated by the major equipment vendors—such as IBM, Siemens-Nixdorf, Olivetti, Digital and Bull; the specialist CAD/CAM vendors—such as Prime and Intergraph; and the major professional services vendors—such as CGS, Sligos, EDS and Sema.

This list of vendors illustrates the point that it is comparatively easy to market technical applications software, such as CAD/CAM, on a pan-European basis, but difficult to achieve pan-European coverage with commercial applications software. The only commercial applications software product vendors to feature in the European top 20 are Computer Associates and SAP, the German vendor of production management systems. Even in this case, SAP's position in the list of leading European vendors is due more to the company's dominance of the German market than its overall penetration of Europe. However, this is changing as the company increases its drive into new markets. The company is already a significant player in France and is becoming known in the U.K. SAP may be helped in achieving greater penetration in other national markets by

Siemens-Nixdorf's increasingly aggressive stance in targeting computer-integrated manufacturing.

EXHIBIT III-2

Leading Vendors, Software and Services Europe, 1991

Rank	Vendor	Country of Origin	Estimated Sector Revenues (\$ Billions)	Market Share (Percent)
1	IBM	U.S.	495	4.7
2	Cap Gemini Sogeti	France	380	3.6
3	Siemens-Nixdorf	Germany	300	2.8
4	Intergraph	U.S.	260	2.4
5	Prime	U.S.	210	2.0
6	Olivetti	Italy	205	1.9
7	Microsoft	U.S.	195	1.8
8	Digital	U.S.	175	1.7
9	Andersen Consulting	U.S.	150	1.4
10	EDS	U.S.	145	1.3
11	Sema Group	France	140	1.3
12	AT&T Istel	U.S.	125	1.1
13	Computer Associates	U.S.	120	1.1
14	SAP	Germany	115	1.1
15	Bull	France	105	1.0
16	Sligos	France	100	0.9
17	HP	U.S.	85	0.8
18	ICL	U.K.	85	0.8
19	Axime	France	80	0.7
20	Unisys	U.S.	70	0.7
	Total Listed*		3,540	33.4
	Total Market		10,600	100.0

*Totals may not add due to rounding.

With the exception of the major U.S. equipment and CAD vendors, the discrete manufacturing sector in each country market has until recently been dominated by indigenous vendors. However, there are clear indications that this domination is starting to change. As companies in the discrete manufacturing sector increase their European focus, software and services vendors are doing likewise.

Some recent examples of acquisitions having a major impact on the discrete manufacturing sector are CGS's joint venture with Daimler-Benz's Debis Systemhaus in Germany; CGS's acquisition of Hoskyns in the U.K. and

Istel involvement with the Rover Group in the U.K. is discounted, then the acquisition of Hoskyns makes CGS the largest professional services supplier to the discrete manufacturing sector in both France and the United Kingdom. CGS already had a significant presence in Italy and now has a major capability in the discrete manufacturing sector in each of the four major European country markets.

Provided CGS can successfully integrate these acquisitions, the company has a major lead over its main European rivals—such as Sligos, AT&T Istel and Sema Group—in providing full European coverage. However, these three companies are also looking to improve their coverage of the discrete manufacturing sector throughout Europe, and more merger activity is likely over the next few years.

B

Key Subsectors

Exhibit III -3 shows the major subsectors within the European discrete manufacturing industry, which corresponds to a considerable degree with the targeting of subsectors practised by software and services vendors. In order of priority, the top subsectors targeted by vendors in 1991 were :

- Automotive
- Electronics
- Aerospace
- Mechanical engineering
- Electrical engineering

The automotive sector in Europe is expected to be one of the major battlegrounds of the 1990s. It has been suggested that the number of vehicle manufacturers in Europe will halve by the year 2000. There has already been a spate of mergers involving European companies.

For example:

- Ford has acquired Jaguar.
- General Motors has taken a 50% shareholding and management control of Saab.
- Fiat now controls Maserati, Innocenti and Alfa Romeo.

Also, Renault and Volvo have held extensive discussions with a view to forming a strategic alliance.

Alongside this merger activity, a major refocusing is taking place in Eastern Europe, leading to a considerable capital investment in the automotive sector. For example, Fiat has embarked on a \$7 billion project in the

USSR, while Volkswagen, amongst others, is looking to significantly increase production within the former East Germany.

All this activity presents opportunities for software and services vendors.

In addition, the automotive sector is coming under greater pressure as both the Japanese vehicle manufacturers and their component suppliers establish their first European plants. Hence, it is now even more imperative for European producers to increase the speed with which new models are brought to market and to reduce their manufacturing costs significantly.

As the Japanese move to the luxury end of the car market, these pressures will increasingly apply to the German luxury car manufacturers, such as BMW and Daimler-Benz, as well as the mass market producers.

EXHIBIT III-3

**Production by Subsector, 1990
Discrete Manufacturing Sector, Europe**

Subsector	Proportion of Total Production (%)
Automotive	18
Electrical engineering	18
Mechanical engineering	17
Manufacture of metal articles	13
Textiles	8
Footwear and clothing	6
Other transportation	5
Printing	5
Office machinery	4
Furniture	3
Other	3

Total 1990 Production = ECU 1430 billion (\$1,920 billion)

Source: INPUT estimate, EEC

While the car industry has traditionally been the leader in terms of process technology, the aerospace industry is one of the leaders in the evolution of product and design technologies. Again, an increasing emphasis is being placed on alliances, and a major restructuring of the industry has recently taken place in Germany around Daimler-Benz. The Deutsche Aerospace Group now includes MTU, MBB, and Telefunken Systemtechnik, and is playing an increasingly important role in the European Airbus project, in which it holds a 38% shareholding.

The automotive and aerospace sectors are those that software and services vendors expect to grow fastest over the next few years. This growth is despite the slump in car sales and the cuts in defence expenditure.

CAD and computer-aided engineering play a major role in assisting both sectors to reduce the time taken to introduce new models. If concurrent engineering can be successfully implemented by users, leading to true sharing of consistent and up-to-date information amongst internal departments and component suppliers, then concurrent engineering could make a major impact on both new model lead times and unit production costs.

At the factory level, the use of JIT procedures—which necessitates the use of EDI for any but the most local of suppliers—can have a significant influence on product quality and production costs. Even the aerospace sector is having to pay more attention to its process technology and cost reduction.

Finally, since many of the larger players in the automotive sector have a considerable investment in factory automation, the ability to integrate this with their production management systems and design systems will lead to much improved management of their facilities and greater production flexibility.

IV Country Forecasts

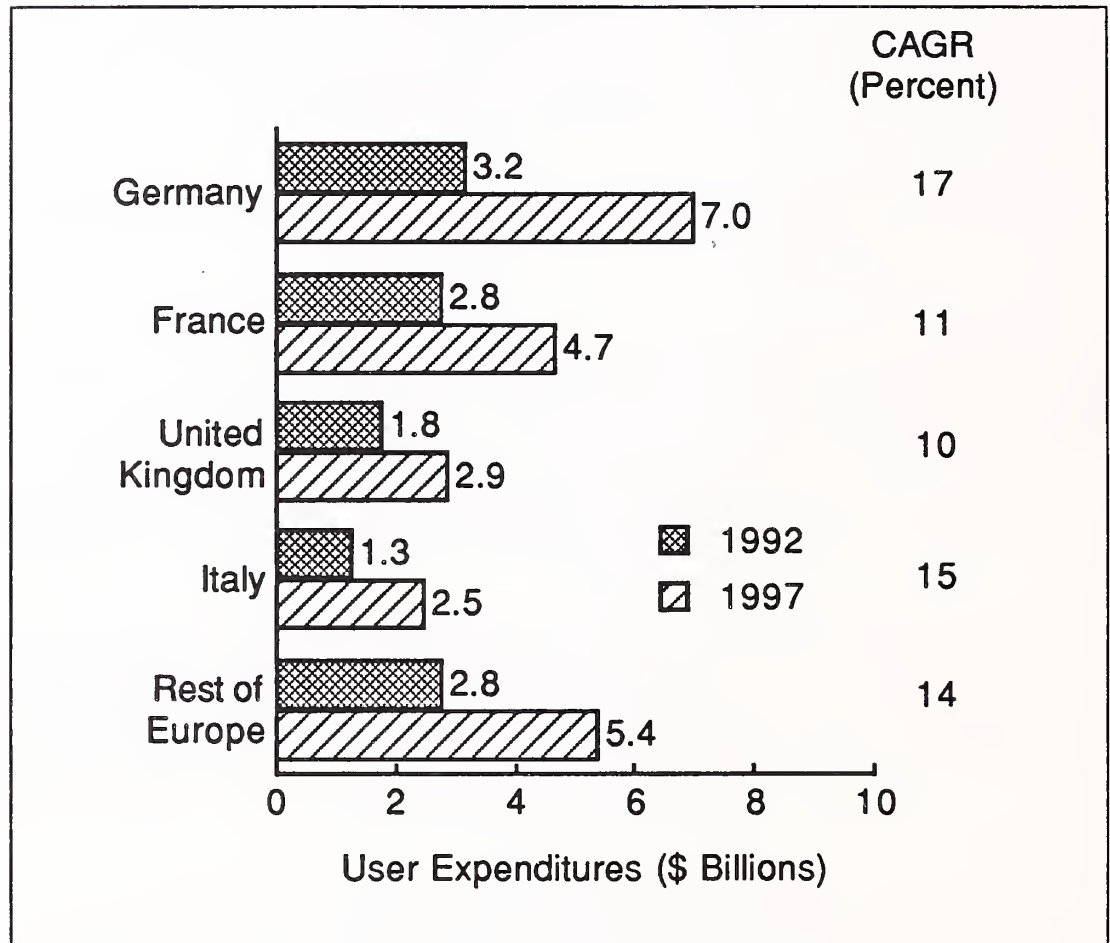
A Overview

Exhibit IV-1 shows INPUT's forecast for the industry-specific software and services markets in the discrete manufacturing sector for each of the major countries.

The major trends within each of these countries are discussed in the following sections of the report. In terms of broad comparisons, the fastest growing markets over the period 1992-1997 are expected to be Germany and Italy, while growth in the United Kingdom, at 10% per annum, will be appreciably lower than the average for Western Europe.

EXHIBIT IV-1

Software and Services Market Forecasts by Country Discrete Manufacturing Sector, Europe



B Germany

The discrete manufacturing sector software and services market forecast by delivery mode for Germany is given in Exhibit IV-2.

EXHIBIT IV-2

Software and Services Market Discrete Manufacturing, Germany

	DM Millions				
	1991	'91-'92 AGR (%)	1992	'92-'97 CAGR (%)	1997
Transaction Processing	480	3	495	2	540
Turnkey Systems	1,260	11	1,400	14	2,750
Applications Software Products	840	18	990	17	2,150
Professional Services	1,000	16	1,160	18	2,600
Network Services	325	23	400	26	1,250
Systems Operations	50	20	60	18	140
Systems Integration	320	22	390	24	1,160
Industry Sector Total*	4,300	14	4,900	17	10,600

*Totals may not add due to rounding.

Germany is widely recognised as having the largest and strongest discrete manufacturing sector in Europe. Indeed, the significance of the German discrete manufacturing sector within Europe can only be expected to increase as a result of the recent reunification with East Germany. As capital investment either in East Germany or to serve the East German market grows, then corresponding opportunities will arise for software and services vendors.

However, it would be a mistake to imagine that the German engineering sector does not suffer from the same pressures felt elsewhere in Europe. Indeed, the high cost of labour in Germany puts an increased onus on the discrete manufacturing sector to reduce its production costs by means of highly automated process technology. In addition, the Germany economy is now starting to feel the effects of the recessionary pressures in its export markets in the U.S. and the other major European economies.

The German equipment vendors—Siemens-Nixdorf (SNI), Digital Kienzle and Taylorix—despite recent mergers, in some cases still have a considerable share (19%) of the software and services revenues from the

discrete manufacturing sector. A list of leading vendors in Germany is shown in Exhibit IV-3.

SNI is starting to aggressively target the computer-integrated manufacturing (CIM) market. The company believes that it is well-positioned to do so, since it is a major electrical conglomerate and manufactures all the hardware required for CIM—from programmable logic controllers (PLCs) to mainframes. Siemens Automation is a complementary business to Siemens Data Systems and has extensive experience in factory automation projects. Typical projects include the installation of flexible manufacturing systems and CNC/DNC implementations.

The remaining German equipment vendors were all traditionally suppliers of turnkey systems on proprietary hardware. Typically, their main target within the discrete manufacturing sector was production management systems. However, these companies have been adversely impacted by the increased acceptance of UNIX. This negative impact resulted in the purchase of Nixdorf by Siemens and the purchase of Kienzle from the Mannesmann Group by Digital.

Although Sigraph puts Siemens in the top five CAD vendors in Germany, the German CAD market is largely dominated by the U.S. vendors. For example, Germany is Intergraph's main country market in Europe. On the other hand, the U.S.-based production management software products vendors find Germany a difficult market to penetrate. The market leader in this segment is the fast-growing local supplier, SAP.

Other independent vendors with a leading position in the German discrete manufacturing software and services market include:

- Ploenzke
- IKOSS

The acquisition of SCS by CGS in 1990 moved CGS into the leading names of independent vendors in Germany, further strengthened by the joint venture with Daimler-Benz subsidiary Debis Systemhouse, which was effective from the start of 1992.

Siemens acquired Calay Systems' CAD activities in the electronics sector to strengthen its position in the electronic design business. Siemens's primary strength remains in the mechanical design market.

EXHIBIT IV-3

Leading Software and Services Vendors Discrete Manufacturing Sector Germany, 1991

Rank	Vendor	Country of Origin	Sector Revenues (DM Millions)	Estimated Market Share (Percent)
1	Siemens-Nixdorf	Germany	300	7.1
2	IBM	U.S.	175	4.1
3	Intergraph	Netherlands	125	3.0
4	SAP	Germany	115	2.7
5	Prime	U.S.	100	2.4
6	Taylorix	Germany	60	1.4
7	Digital	U.S.	55	1.3
8	Microsoft	U.S.	55	1.3
9	DAT-Gruppe	Germany	50	1.2
10	Computer Associates	U.S.	45	1.1
	Total Listed*		1,080	25.7
	Total Market		4,250	100.0

*Totals may not add due to rounding.

C

France

The prospects for industry-specific software and services in the French discrete manufacturing sector lie between the buoyancy of the German market and the comparatively depressed state of the market in the United Kingdom.

A depressed market was made worse in 1991 by defence cuts and a drop in consumer demand for cars. Exhibit IV-4 gives a breakdown of the French market by delivery mode.

EXHIBIT IV-4

Software and Services Market Discrete Manufacturing, France

	FF Millions				
	1991	'91-'92 AGR (%)	1992	'92-'97 CAGR (%)	1997
Transaction Processing	1,480	5	1,550	2	1,750
Turnkey Systems	2,900	9	3,150	8	4,700
Applications Software Products	2,750	16	3,200	16	6,850
Professional Services	3,850	9	4,200	4	5,200
Network Services	1,120	21	1,350	21	3,500
Systems Operations	470	21	570	23	1,600
Systems Integration	290	19	345	18	780
Industry Sector Total*	12,850	12	14,350	11	24,400

* Totals may not add due to rounding.

Four of the leading ten companies in the European discrete manufacturing sector are French. These are the two major car manufacturers: Renault and Peugeot; and the electronics companies: CGE and Thomson-CSF. France has a very strong presence in the European aerospace sector through the Airbus consortium and companies such as Aerospatiale and Dassault Breguet. France has a majority stake in the Ariane space launch venture. Unlike the discrete manufacturing software and services market in Germany, where the indigenous equipment manufacturers play a major role, in France the leading group is the French professional services companies. The two market leaders are CGS and Sligos. Indeed, these two companies are the leading independent vendors serving the discrete manufacturing sector for Europe as a whole.

Their leadership position in the sector has been further strengthened recently by acquisition. CGS has acquired Hoskyns and SCS, while Sligos has purchased Mesarteam. As well as increasing their overall market shares in the discrete manufacturing sector, these acquisitions have further improved each company's coverage outside France.

Bull moved to make its production management system, HDMS Plus, more European in outlook, by incorporating multilanguage and multicurrency features.

Besides those shown in Exhibit IV-5, leading independent vendors in France serving the discrete manufacturing sector include Dataid, now part of AT&T Istel, and Steria.

EXHIBIT IV-5

**Leading Software and Services Vendors
Discrete Manufacturing Sector
France, 1991**

Rank	Vendor	Country of Origin	Estimated Sector Revenues (FF Millions)	Market Share (Percent)
1	Cap Gemini Sogeti	France	590	4.6
2	IBM	U.S.	460	3.6
3	Sligos	France	450	3.5
4	Axime	France	410	3.2
5	EDS-GFI	U.S.	315	2.4
6	Sema Group	France	300	2.3
7	Bull	France	270	2.1
8	CISI	France	255	2.0
9	Microsoft	U.S.	240	1.9
10	CGI	France	185	1.5
	Total Listed*		3,475	27.1
	Total Market		12,850	100.0

*Totals may not add due to rounding.

D**United Kingdom**

For much of 1990 and 1991, the discrete manufacturing sector in the U.K. was depressed. This remains the case in early 1992. The primary cause of this depression is the relatively high level of interest rates in the United Kingdom. In this environment, many software and services companies are finding that they are asked to bid for projects, only for the project then to be indefinitely postponed. With this slowdown in growth, vendors are finding that the market is becoming very competitive, with increasing price competition. A breakdown of the U.K. market by delivery mode is given in Exhibit IV-6. From 1990 to 1991, the market showed no real growth, but software and services are expected to grow 7% (including inflation) during 1992.

EXHIBIT IV-6

**Software and Services Market
Discrete Manufacturing, United Kingdom**

	£ Millions				
	1991	'91-'92 AGR (%)	1992	'92-'97 CAGR (%)	1997
Transaction Processing	84	1	85	2	93
Turnkey Systems	245	4	255	7	355
Applications Software Products	164	10	180	10	295
Professional Services	215	7	230	9	350
Network Services	79	14	90	18	205
Systems Operations	38	18	45	22	123
Systems Integration	44	14	50	16	103
Industry Sector Total*	870	7	935	10	1,520

* Totals may not add due to rounding.

As in the rest of Europe, the subsectors of discrete manufacturing industry perceived to be most promising for vendors are, in order of level of optimism:

- Automotive
- Aerospace
- Electronics

In the automotive sector, the market for industry-specific software and services was buoyed by the demand generated by Japanese entrants. In particular, this demand was having a beneficial impact for software and services vendors in the automotive components sector. The indigenous suppliers were benefiting from increased demand for their products. In addition, new entrants from Germany and Japan were arriving to service the new vehicle assemblers. All this activity was viewed favourably by software and services vendors. New vehicle sales declined significantly at the beginning of 1991, generating a much less buoyant outlook for the sector in the short term.

Exhibit IV-7 shows the leading vendors offering industry-specific software and services to the discrete manufacturing sector.

Although AT&T Istel is the leading vendor in the U.K., this position owes more to the company's former parentage than its overall penetration of the discrete manufacturing sector. The bulk of its revenues in the discrete manufacturing sector are still derived from the Rover Group. Istel, now owned by AT&T, has acquired several European companies that have similar industry sector strengths to those of Istel in the U.K. AT&T Istel is determined to become a major pan-European vendor.

U.S.-based vendors—such as Intergraph, Prime/Computervision, IBM, and at the low end of the market Autodesk—dominate the CAD market in the United Kingdom.

Similarly, while there are some successful U.K.-based vendors of production management systems, such as Kewill and CSD (now AT&T Istel Impcon Solutions), the United Kingdom market has been heavily penetrated by the U.S. vendors, such as:

- Computer Associates with IBM mainframe-based systems
- ASK and CINCOM with DEC-based systems
- SSA and Dun & Bradstreet with AS/400-based systems

The United Kingdom production management systems market is also increasingly coming under attack from SAP, which is targeting and achieving high levels of European growth.

EXHIBIT IV-7

Leading Software and Services Vendors Discrete Manufacturing Sector U.K., 1991

Rank	Vendor	Country of Origin	Sector Revenues (£ Millions)	Estimated Market Share (Percent)
1	AT&T Istel	U.S.	60	6.9
2	Hoskyns (CGS)	U.K. (France)	55	6.3
3	IBM	U.S.	40	4.6
4	Prime	U.S.	40	4.6
5	ICL (Fujitsu)	U.K. (Japan)	35	4.0
6	EDS-Scicon	U.S.	30	3.4
7	Sema Group	France	25	3.0
8	McDonnell Douglas	U.S.	25	3.0
9	Intergraph	U.S.	25	2.9
10	Andersen Consulting	U.S.	25	2.7
	Total Listed*		360	41.4
	Total Market		870	100.0

* Totals may not add due to rounding.

E

Italy

While the large discrete manufacturing companies in Northern Italy—such as Fiat—can be expected to be at the forefront of JIT, factory automation and integration of systems, much of the Italian discrete manufacturing sector is unsophisticated. This means that users only require comparatively low levels of functionality in their systems. The nature of Italian accounting also presents difficulties for non-indigenous vendors.

As a result, Italy is an area where many vendors would like to increase their sales, but where vendors have had comparatively low levels of success to

date. This is particularly true for production management software product vendors, such as ASK and CINCOM.

Considerable growth is expected in systems integration and manufacturing consultancy over the next few years. However, the discrete manufacturing sector in Italy was slightly depressed throughout 1990. In the longer term, the country's textiles sector is at risk from cheap imports. Growth and expenditure forecasts by delivery mode for the Italian market are shown in Exhibit IV-8.

EXHIBIT IV-8

Software and Services Market Discrete Manufacturing, Italy

	Lira Billions				
	1991	'91-'92 AGR (%)	1992	'92-'97 CAGR (%)	1997
Transaction Processing	150	3	155	1	165
Turnkey Systems	320	9	350	10	575
Applications Software Products	310	16	360	18	830
Professional Services	315	13	355	14	670
Network Services	109	19	130	23	360
Systems Operations	42	19	50	21	128
Systems Integration	58	21	70	21	185
Industry Sector Total*	1,300	13	1,470	15	2,900

* Totals may not add due to rounding.

With many of the major European professional services companies looking to increase their presence in Italy, a certain amount of merger and acquisition activity can be expected over the next few years. One example of this Sligos's acquisition of Mesarteam—an Italian vendor specialising in the discrete manufacturing sector.

Exhibit IV-9 shows the leading vendors in the Italian discrete manufacturing software and services market. Three of the top ten vendors are equipment vendors: Olivetti, IBM and Bull.

CGS maintains its position as the leading independent professional services vendor, serving the European discrete manufacturing sector. CGS is in the top ten vendors in France, the United Kingdom and Italy, and is also a significant vendor in Germany.

EXHIBIT IV-9

**Leading Software and Services Vendors
Discrete Manufacturing Sector
Italy, 1991**

Rank	Vendor	Country of Origin	Estimated Sector Revenues (Lira Billions)	Market Share (Percent)
1	Olivetti	Italy	145	11.2
2	IBM	U.S.	90	7.0
3	Finsiel	Italy	60	4.7
4	Microsoft	U.S.	30	2.2
5	Cap Gemini Sogeti	France	25	2.0
6	Datamat	Italy	25	2.0
7	S&M Group	Italy	20	1.6
8	Andersen Consulting	U.S.	20	1.6
9	Siemens-Nixdorf	Germany	20	1.6
10	Bull	France	20	1.6
	Total Listed*		455	35.0
	Total Market		1,300	100.0

* Totals may not add due to rounding.

V

Key Delivery Modes

A

Overview

Exhibit V-1 shows the growth in industry-specific revenues for the European discrete manufacturing sector by delivery mode.

The forecast average growth rate over the period 1992-1997 is 14%. However, there is considerable variation from this average by delivery mode.

As the emphasis in the discrete manufacturing sector changes, the turnkey systems and applications software products markets will slow down. Over the same period, higher levels of growth will be seen in the professional services and systems integration sectors. This change is because the emphasis in the discrete manufacturing sector is no longer on implementing standalone applications such as CAD and production management. The larger discrete manufacturing companies have been using such systems for some years and are now keen to integrate their existing application areas.

The implementation of higher levels of integration can take several forms. One approach is to link together the existing systems, using either internal IS staff or a professional services vendor. The other approach is for the user to replace all existing applications with a new set of applications that are known to be readily integratable. Both of these approaches are being observed in the marketplace.

Other high-growth delivery modes include network services and systems operations. Network services will benefit from the substantial increase in the usage of EDI as users start to evolve from the trial stage and markedly extend the number of transactions being performed via networks.

Systems operations will also grow as information systems departments come under increasing cost pressures in the discrete manufacturing sector

and as companies move away from using centralised mainframe-based systems.

EXHIBIT V-1

Software and Services Market Discrete Manufacturing, Europe

	U.S. Dollars (Millions)				
	1991	'91-'92 AGR (%)	1992	'92-'97 CAGR (%)	1997
Transaction Processing	1,210	3	1,250	2	1,380
Turnkey Systems	2,810	9	3,050	11	5,130
Applications Software Products	2,240	16	2,590	16	5,410
Professional Services	2,610	11	2,910	12	5,060
Network Services	970	20	1,160	22	3,150
Systems Operations	295	19	350	22	940
Systems Integration	465	19	555	22	1,480
Industry Sector Total*	10,600	12	11,850	14	22,550

* Totals may not add due to rounding.

B

Software Products

The major application areas supported by software products in the discrete manufacturing sector are shown in Exhibit V-2. The two principal applications in 1992 remain:

- Production management
- CAD/CAM

However, shopfloor data collection and control and production engineering applications are increasing in importance.

The market forecast for software products in the discrete manufacturing sector is shown in Exhibit V-3.

EXHIBIT V-2

Software Products Market by Application, 1992 Discrete Manufacturing Sector, Europe

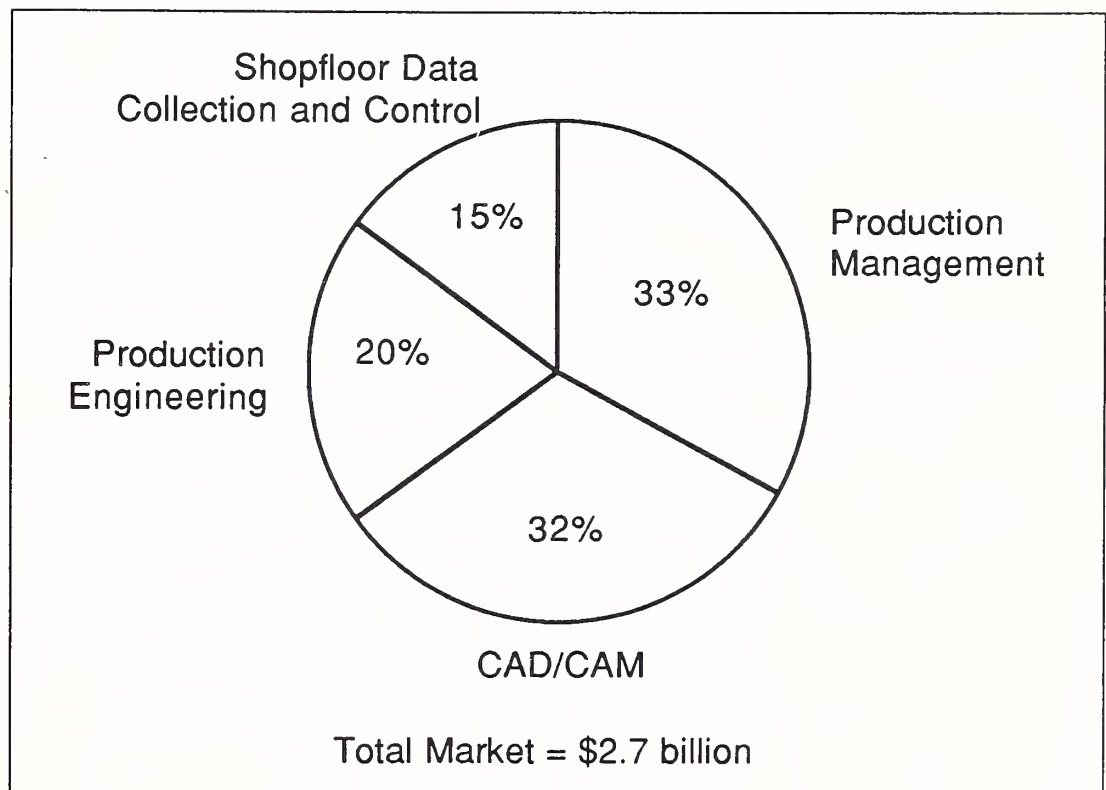


EXHIBIT V-3

Applications Software Products Market Discrete Manufacturing, Europe

	U.S. Dollars (Millions)		
	1992	'92-'97 CAGR (%)	1997
Mainframe	170	0	170
Minicomputer	750	10	1,200
Workstation	530	21	1,400
Micro/PC	1,140	18	2,640
Total	2,590	16	5,410

Levels of growth are expected to be very low for mainframe-based software. For example, CAD is no longer typically implemented on mainframes. The workstation, and increasingly the microcomputer, have become the primary CAD equipment platforms. One of the most important influences in the CAD market has been, and will remain, the rapidly reducing “cost per seat”. Even IBM is publicly recognizing this trend, with increased emphasis on the RS/6000 as the equipment platform for products such as CATIA. IBM has also in the last year introduced microcomputer-based CAD systems to provide entry-level systems.

Similarly for production management systems, the emphasis has changed in favour of minicomputer-based systems. For example, Xerox—formerly one of the major suppliers of mainframe-based MRPII systems—in 1990 announced a new MRPII product, which will also run on the RS/6000 and DEC Vax. Support for the AS/400 and UNIX-based systems are planned for future release. Likewise, Dun & Bradstreet has launched AMAPS/400, a production management system for the AS/400, and is developing UNIX versions.

Overall, the level of growth in software products is much higher for minicomputers than mainframes. Minicomputers remain the basic workhorse for MRPII installations, though there are signs of a slowdown in the Digital Vax-based market. Certainly, many of the major vendors of Digital-based MRPII systems are developing the latest versions of their systems to run under UNIX. This route is being taken by ASK and Cincom. Another trend in the production management segment is the move towards building more sophisticated levels of distribution system into the products.

One sector showing strong growth towards the end of 1990 was the market for AS/400-based production management systems. In addition to companies migrating from the System/38 and System/36, there is a significant move to AS/400 from companies formerly running their production management system on mainframes. This movement is true for both IBM and non-IBM mainframe users.

Overall, IBM is placing considerable emphasis on its intermediate computer-integrated manufacturing (I-CIM) products, such as:

- S/400 and MAAPICS DB
- RS/6000 and CATIA
- Industrial computer and SFDC

CATIA is a vital part of IBM's product range, and the company is believed to be in the process of purchasing a significant stake in Dassault Systems to exercise greater influence over the company. Growth will remain highest at the microcomputer level. Much of the growth in the CAD market is taking place at the low end of the market. Major CAD vendors, such as Intergraph

and Prime/Computervision, have responded to the success of Autodesk by launching their own microcomputer-based products:

- Intergraph with the Microstation drafting product
- Prime/Computervision with Personal Designer

Intergraph estimates worldwide sales for Microstation to have reached \$60 million in 1990.

Similarly, there is appreciable demand from small discrete manufacturing organisations for microcomputer-based production management systems. The importance of this sector of the market in 1991 is shown in Exhibit V-4.

EXHIBIT V-4

**Production Management Software Products
Breakdown by Platform, 1991
Discrete Manufacturing Sector, Europe**

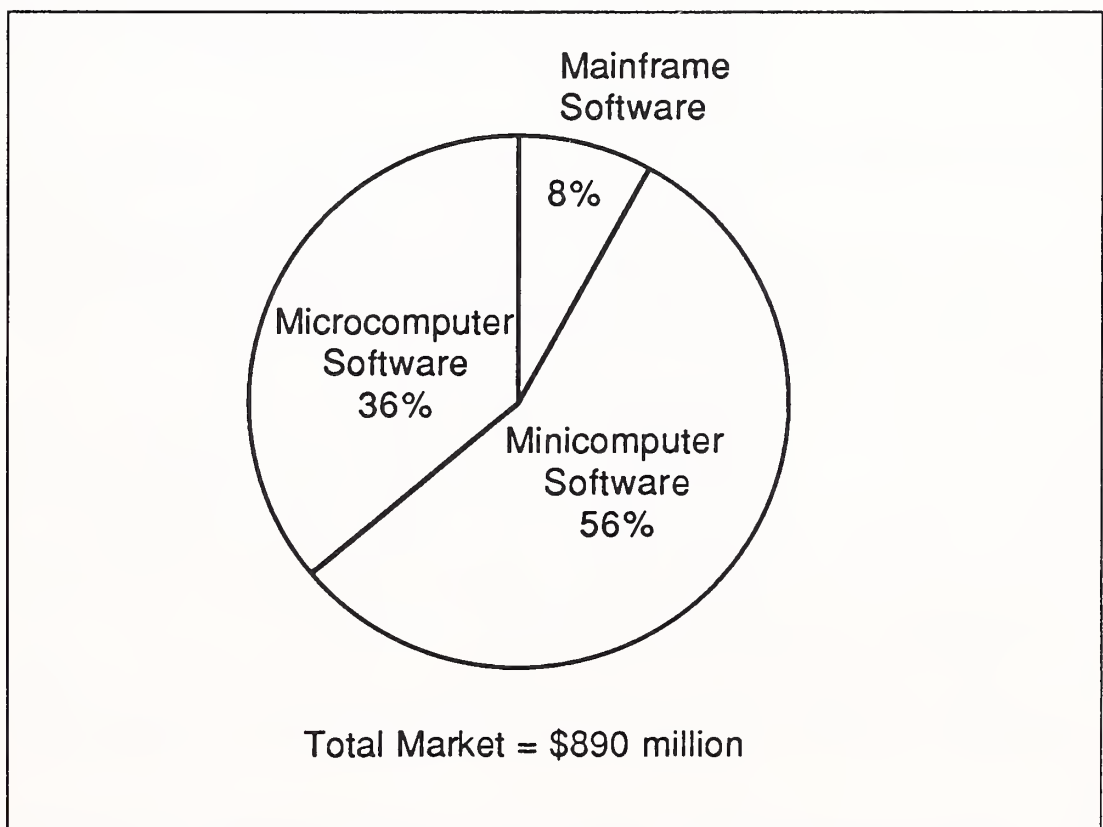


Exhibit V-5 shows the levels of demand forecast by users across the major application areas, while Exhibit V-6 illustrates vendor expectations broken down by equipment type.

EXHIBIT V-5

User Purchasing Intentions Discrete Manufacturing Sector, Europe

Application	Level of Purchasing Intent
Shopfloor data collection and control	High
Production management	Medium
CAD/CAM	Medium
Engineering data management	Low

A high level of demand is forecast by both users and vendors for shopfloor data collection and control systems, which reflects the increased need to closely monitor events on the factory floor and maintain tighter control over production schedules. Such systems give production managers the levels of feedback necessary to provide a more flexible and responsive service to their customers.

Production management systems can expect moderate levels of growth overall. The minicomputer-based production management software market is primarily a replacement market. However, there could be a fresh surge of growth if a significant move to UNIX-based systems occurs in the discrete manufacturing sector.

Engineering data/document management is one of the principal growth areas targeted by the major hardware vendors, such as IBM and Digital, and by the specialist CAD vendors. However, apart from a few leading edge users, such as British Aerospace, there is little sign of user activity in this area at present. Nor is this application currently planned for implementation by the typical user.

EXHIBIT V-6

Vendors' Perception of Growth in Discrete Manufacturing Sector—Software Products by Application and Equipment Platform

Equipment Platform	Application			
	CAD/CAM	Engineering Database Management	Production Management	Shopfloor Data Collection Control
Microcomputer and workstation	High	Low	Medium	High
Minicomputer	Low	High	Medium	High
Mainframe	Low	High	Low	Low

C

Turnkey Systems

The composition of the turnkey systems market by application is shown in Exhibit V-7.

The turnkey systems delivery mode remains the key delivery mode for CAD/CAM systems. However, few European vendors are amongst the leading CAD suppliers to the discrete manufacturing sector. Most of the leading vendors are U.S.-based. The principal European vendors are:

- Siemens
- Cisigraph
- Pafec

CAD is a key technology for users in the discrete manufacturing sector, as users endeavour to reduce the time required to introduce new products and to reduce production costs. Accordingly, the leading CAD vendors are seeking to develop the use of concurrent engineering and engineering data management.

Production management systems are also an important area for turnkey systems vendors. Traditionally, this was particularly true for the midrange proprietary equipment vendors, such as Nixdorf and Mannesmann Kienzle. In addition, the mainframe equipment vendors—such as IBM, Siemens, Bull and ICL—offer turnkey production management systems.

The traditional proprietary turnkey systems vendors such as Nixdorf and Kienzle have been amongst the first vendors to suffer from the overall move to open systems. As a result, Nixdorf was acquired by Siemens and Kienzle by Digital during 1990.

Turnkey systems based on UNIX will become increasingly important in the future, particularly on midrange equipment platforms.

EXHIBIT V-7

Turnkey Systems by Application, 1992 Discrete Manufacturing Sector, Europe

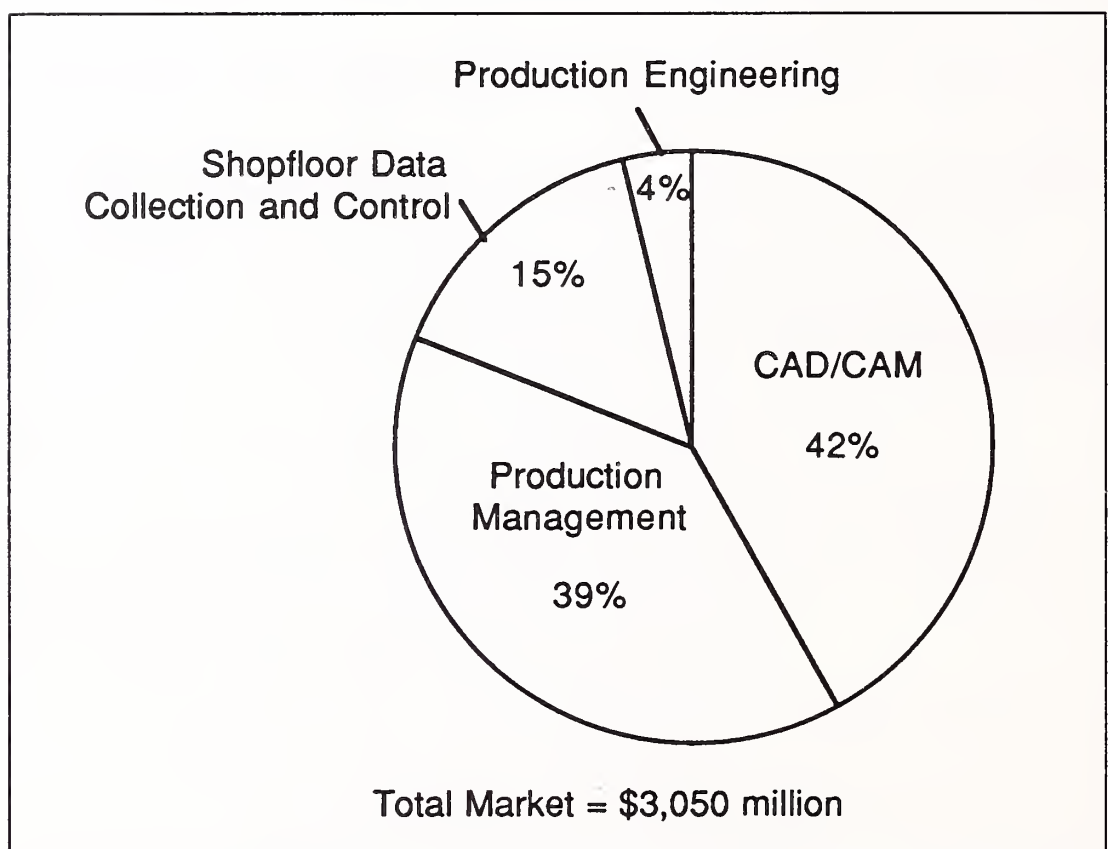


Exhibit V-8 shows the importance that vendors attach to shopfloor data collection and control (SFDCC). SFDCC is increasingly becoming an integral part of the software products vendors' MRPII systems. However, SFDCC is also important as an application in its own right. Shopfloor data collection and control covers a number of uses, such as:

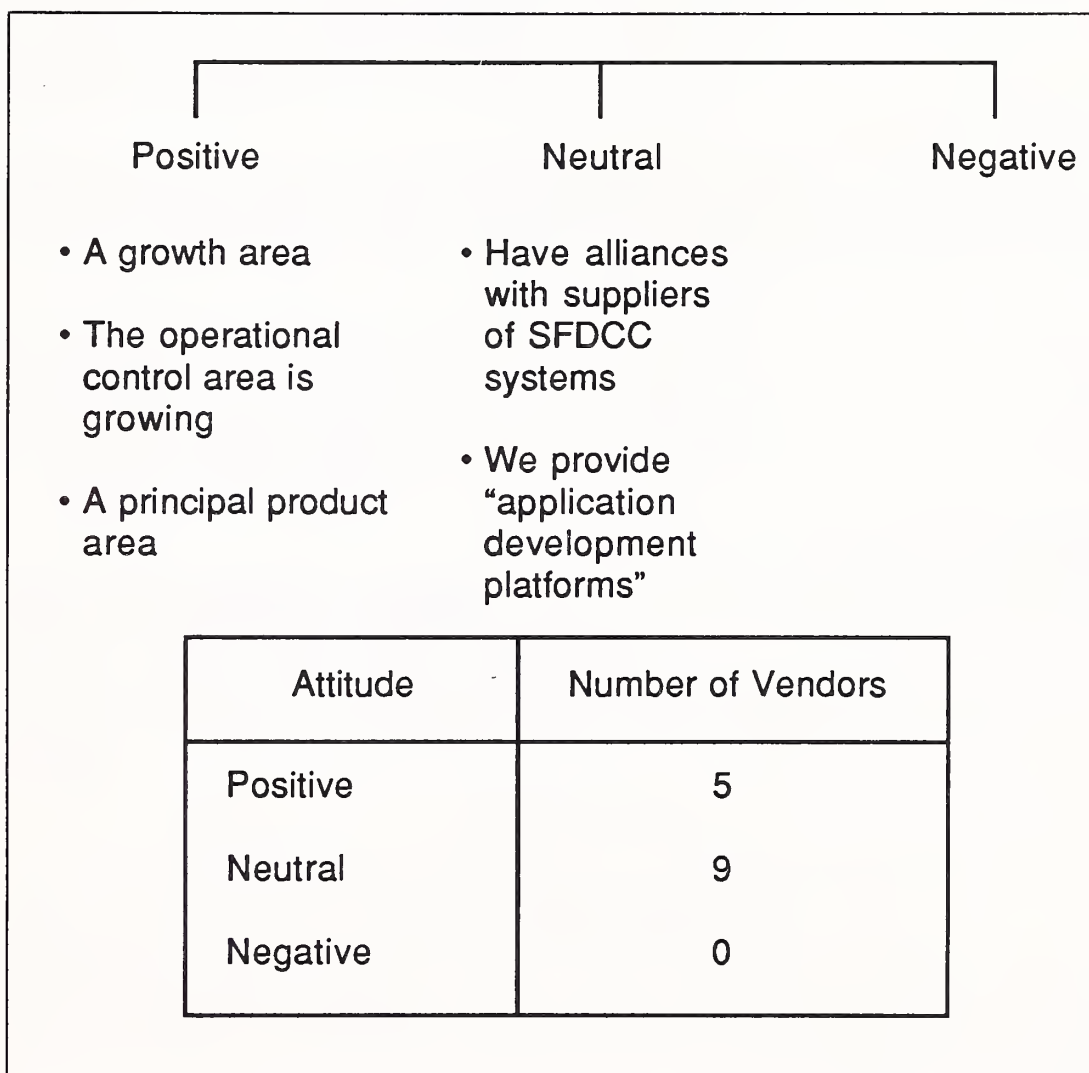
- Inventory and WIP tracking
- Workforce monitoring
- Cell control

SFDCC is now being extended to cover areas such as:

- Maintenance
- Statistical process control

EXHIBIT V-8

Vendor Attitudes Towards Shopfloor Data Collection and Control



D

Professional Services

Professional services, in the form of consulting, development projects, contract staff and training will grow more slowly than anticipated by INPUT's previous research. The rapid switch to application packages and move to off-the-shelf solutions is changing the form of services demanded.

IS consulting and systems integration are expected to dominate the areas of high growth, even in times of economic hardship.

While some users will carry out the necessary work to integrate their systems in-house, an increasing proportion will turn to professional services vendors for assistance.

The growth in professional services will be driven by the enabling products being provided by the major equipment vendors—such as IBM, Unisys and Digital. These companies are providing architectures to enable their users to move towards computer-integrated manufacturing. While providing a mechanism for establishing the appropriate links between applications, considerable bespoke work is still required to make this happen.

As information systems move down the organisation to the shopfloor, education and training become even more important in ensuring successful implementation.

The key areas requiring integration are shown in Exhibit V-9. The larger and even medium-sized discrete manufacturing companies have been using production management systems for many years. Users' current need is to integrate these systems with their CAD systems and with the shopfloor.

EXHIBIT V-9

User Integration Plans Discrete Manufacturing Sector, Europe

Area of Integration	Number of Users Planning Integration
CAD and MRPII	5
MRPII and shopfloor	4

Sample of five discrete manufacturing companies.

Many of the large users will attempt to carry out this work in-house, but as cost pressures increase on IS departments, an increasing proportion of vendors will turn to professional services vendors for assistance.

Another factor likely to lead to increased use of third parties is the changing pattern of work required, with less emphasis on commercial systems and increased emphasis on integration with factory automation systems. Obviously, this change requires new skills, which may not be readily available to the user in-house.

E**Systems Integration**

Many users are looking in the long-term to move towards a computer-integrated manufacturing environment. In a fully integrated environment, closed-loop management systems would apply to both production and design cycles. At the design stage, this system would lead to lower-cost, more reliable products being brought to market more rapidly. At the production stage, the consequences would be tighter management of office and shopfloor procedures, leading to reduced delivery times and greater responsiveness to clients. However, such systems are a long way from reality at the present time.

Nonetheless, users are moving steadily towards this goal, and considerable activity is being seen at both ends of production management systems. The main players in systems integration in the discrete manufacturing sector in Europe are the professional services vendors, such as:

- CGS
- Sligos
- Sema Group
- Andersen Consulting
- EDS

The major consultancies—such as Coopers & Lybrand, Deloitte and Price Waterhouse—will try to increase their presence.

However, the major threat to the professional services companies comes from the major equipment vendors—such as IBM, Digital, SN, and Unisys.

All of these companies are targeting systems integration within the discrete manufacturing sector. SNI has the added advantage of being a manufacturer of PLCs, and so has considerable credibility in factory automation projects. To increase their credibility as business consultants to the discrete manufacturing sector, IBM and Digital are making extensive use of their internal manufacturing experts in offering advice to clients.

However, in spite of the CIM architectures and enabling products being provided by the equipment vendors, the systems integration market remains difficult for any single vendor to tackle on its own. Hence collaboration—whether for additional software products, particular industry expertise, or technical skills—remains important.

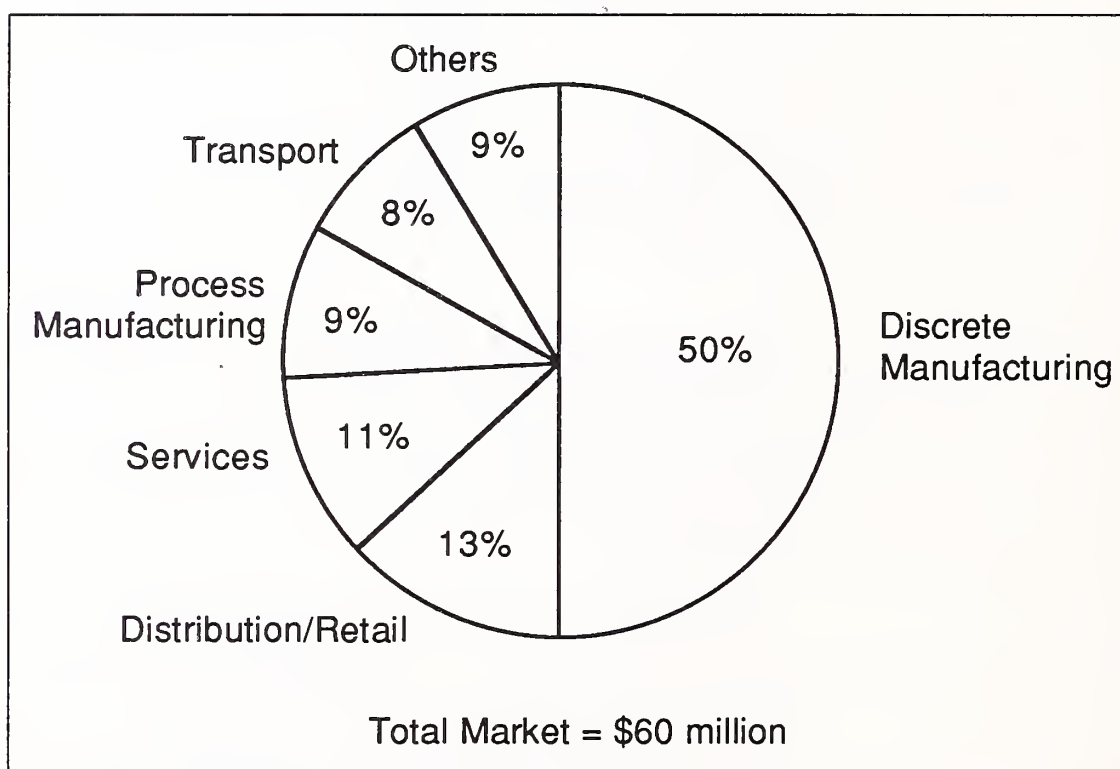
F

Network Services

EDI is forecast to be a major growth area for the discrete manufacturing sector over the period 1992-1997. Led by the automotive manufacturers, EDI is already used to a limited extent by many discrete manufacturing companies, and this level of use was sufficient to make the discrete manufacturing industry the leading sector in the introduction of EDI within Europe in 1991, as shown in Exhibit V-10. The overall significance of this sector is likely to remain relatively unchanged in 1992.

EXHIBIT V-10

European EDI Markets by Vertical Sector, 1991



However, there remains considerable scope to extend the usage of EDI, in terms of the number of organisations linked and the variety of transactions. In the automotive sector, Daimler-Benz, Volvo and General Motors seem likely to insist on EDI capability from their suppliers within the next few years.

In the United Kingdom, an Electrical Industry Electronic Data Interchange group has been formed to promote EDI within the electrical sector. The

group consists of a number of major manufacturers and wholesalers, including GTE Sylvania, MK Electric and Philips Lighting.

As in other sectors, the major EDI concerns relate to the use of standards. In particular, the lack of global standards appropriate for companies operating factories across Europe is causing users some concern.

If the standards issue is not resolved, the exchange of CAD data may overtake the electronic exchange of commercial data as the most important application for discrete manufacturing companies. As links to key suppliers become an increasingly important part of product design, a strong need for graphics exchange within the manufacturing sector emerges.

This increased need is particularly true for the automotive, aerospace and textiles sectors. In the automotive sector, for example, the vehicle assemblers are developing much closer relationships with their component suppliers. This necessitates frequent exchange of design data, and the Automobile Industry Action Group is undertaking the task of establishing standards for the exchange of computer graphics files. At present, a subcontractor commonly acquires the same make of CAD system as their major client so that data can readily be exchanged via magnetic tape.

G

Systems Operations

For many systems operations vendors, the discrete manufacturing sector lags in importance. However, this may now be starting to change, particularly in France and the United Kingdom. Pressures on IS departments in the manufacturing sector are increasing, as there are increasing doubts concerning IS departments' cost effectiveness and ability to deliver. Accordingly, users are reporting a reduction in IS department staffing and an increasing reliance on external vendors. Initially, this change may just mean an increased spending on professional services, but in some cases, it will also lead to the adoption of systems operations by the user.

This increased reliance on external vendors will be particularly pronounced where there is a major refocusing of the information systems to meet business needs. In extreme cases, complete replacement of internal information systems development by a systems operations vendor can occur. Even in less extreme cases, such as a significant downsizing of the equipment used, a systems operations vendor may be used to run and maintain the existing systems while redevelopment is carried out by the internal information systems personnel.

VI

Computer-Integrated Manufacturing

A

Driving Forces

Traditionally, much of the European manufacturing industry viewed efficiency as synonymous with high utilisation of machines and direct labour. This approach was often enforced via a rigid, hierarchical organisational structure with strict departmental boundaries. The result was organisations where individual personnel felt a lack of ownership and change became difficult to implement. At the same time, quality levels were slow to rise and large quantities of work-in-progress resulted from the emphasis on utilisation at each stage in the production process.

While organisations have recognised for the last decade that these problems were impacting their global competitiveness, only comparatively recently have organisations recognised the need to concentrate on improved responsiveness to their clients as their top priority.

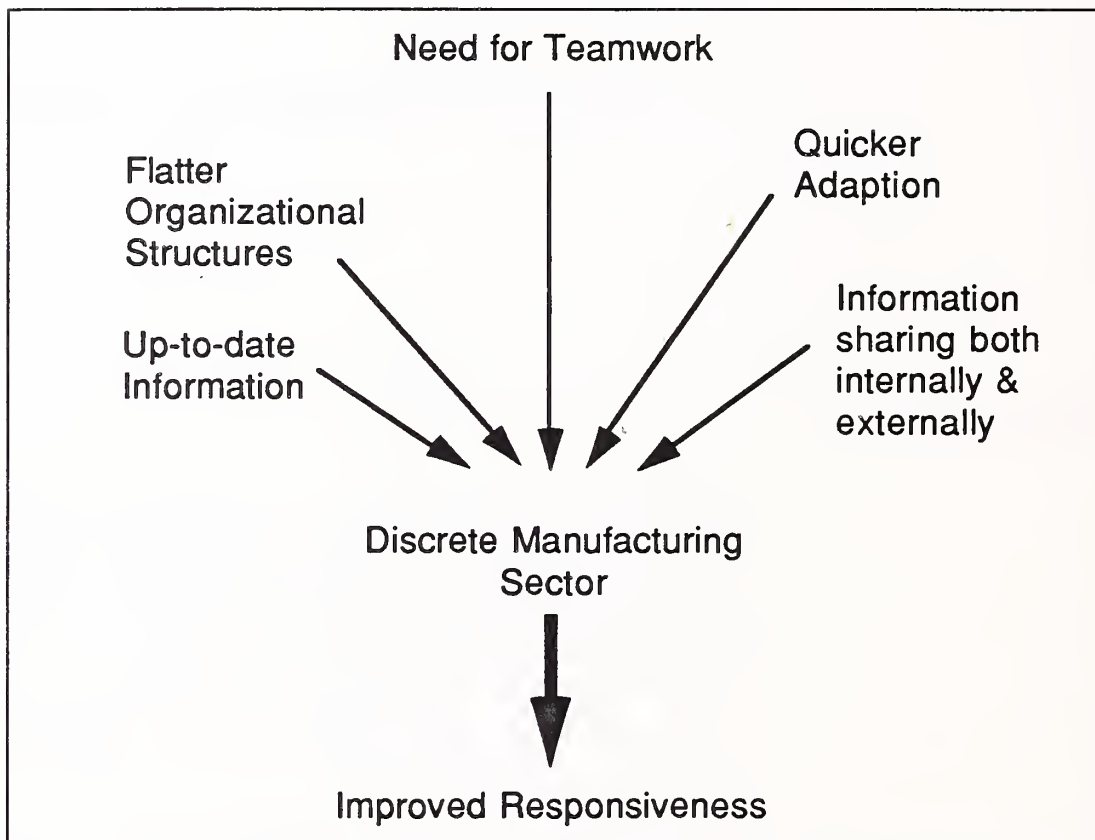
This improved responsiveness takes a number of forms, including:

- Speed of new product development
- Capability to adapt existing products
- Ability to offer greater model variety within a product range
- Shortened delivery/production lead times

Some of the key organisational attributes required for improved responsiveness are illustrated in Exhibit VI-1.

EXHIBIT VI-1

Driving Forces, Computer-Integrated Manufacturing Discrete Manufacturing Sector, Europe



Firstly, many companies recognise that this increased responsiveness is best achieved by an emphasis on effectiveness rather than efficiency and that a greater emphasis on information sharing and teamwork is required.

The most obvious example illustrating the need for teamwork is concurrent engineering, where the sharing of information between design and production engineers is making a major impact in reducing the time to introduce new products. Similarly at the manufacturing level, flatter organisational structures and the use of cellular product teams simplify the production process and its administrative requirements while restoring ownership and responsibility for quality to production personnel.

As well as the dramatic organisational changes taking place within manufacturing organisations, the nature of their relationships with suppliers and clients are also changing. These relationships are becoming more strategic in nature with less emphasis on price comparison and more sharing of information.

B**Buying Process**

Exhibit VI-2 indicates the importance attached by vendors to the roles of user personnel in the CIM purchasing decision.

Top management is becoming increasingly involved in CIM decisions for a number of reasons. Firstly, CIM is likely to have a cross-departmental impact on the whole organisation and has considerable implications for the nature of the organisation and its structure. Secondly, any CIM implementation must support the overall business strategy in both the short- and the long-term, and has the potential to make a pronounced impact on business performance. In addition, the considerable expenditure involved necessitates the review of any projects at least at board level, and top management is becoming increasingly computer literate and able to make its own judgement on the relevance of information systems projects.

Direct contact between vendors and manufacturing management is also important, while the role of the information systems department as an initiator of CIM projects is decreasing. However, some vendors are finding that balanced user project teams that incorporate both manufacturing and IS personnel are becoming more commonplace. Such an approach has much to commend it since it enables the user to take a more informed view of business, technical and operating issues, all of which are important for the success of the project.

EXHIBIT VI-2

**Importance in Buying Process
Computer-Integrated Manufacturing, Europe**

User Personnel	Degree of Importance
Top management	High
Manufacturing management	Medium - High
IS management	Medium - High

Exhibit VI-3 identifies the relative importance of a number of means of lead generation broken down by vendor type.

In line with the view that one of the dominant concerns of the major equipment vendors is account control, the major equipment vendors regard their account managers as their most important source of leads for CIM projects. The role of account managers is to make contact with senior user

management and to ensure that the vendor's approaches to CIM are the ones adopted. Typical techniques used include management workshops for identification of the user organisation's critical success factors. Solutions are then proposed to meet the identified business requirements.

While companies are increasingly buying CIM using management consultancies as advisers/intermediaries, the equipment vendors attached low importance to their contacts with management consultancies. This low importance rating may reflect the current low levels of business arising from management consultancies. Certainly a number of vendors are aiming to increase the amount of business generated via this channel. For example, IBM has recently established a joint venture with Coopers & Lybrand in the U.S. with the intention of targeting CIM in the process and discrete manufacturing sectors.

EXHIBIT VI-3

Importance in Lead Generation Computer-Integrated Manufacturing, Europe

Vendor Category Means of Lead Generation	Equipment Vendors	Professional Services Vendors	Application Software Product Vendors
Account Managers	High	Medium	High
New Business Sales Force	Medium	High	High
Collaboration Partners	Medium	High	Medium
External Consultants	Low	Medium	High

The professional services vendors have not yet developed the sample calibre of account management skills as the equipment vendors, and they regard their new business sales forces and collaboration partners as their most important means of lead generation. Their collaboration partners include the equipment vendors that have a major need for partners with the detailed capability to implement CIM projects.

Applications software product vendors attached more importance than the other vendor groups to the role of external consultants in lead generation. The adoption of CIM is becoming package-led and so applications software products will be needed by consultants as part of their recommendations to the client.

All categories of vendors recognise the importance of focusing considerable attention on user top management, as shown in Exhibit VI-4.

However technological arguments are not the most appropriate to use with top management. Prior to any discussion of information systems, the vendor must identify the company's business goals and demonstrate in business terms how improved performance could be achieved.

EXHIBIT VI-4

Importance of Business Consulting Computer-Integrated Manufacturing, Europe

<div style="display: flex; align-items: center; justify-content: center;"> <div style="writing-mode: vertical-rl; transform: rotate(180deg);">Approach</div> <div style="border: 1px solid black; padding: 5px; margin: 0 10px;">Vendor Type</div> </div>	Level of Importance		
	Equipment Vendors	Professional Services Vendors	Application Software Product Vendors
Offering Business Consulting	High	Low	High
Focusing on user's top management	High	High	High

Accordingly, business consulting is increasingly the route to CIM projects. This has been recognised for some time by the equipment vendors that have been endeavouring to use their own internal personnel in this role. At present, business consulting can be a weakness for many of the professional services vendors. However, a number of leading companies, such as CGS, have recognised the limitations of their present approaches. In the case of CGS, this recognition has led to the acquisition of a number of business consultancies.

Applications software product vendors also claim to offer business consulting. However, their skills may well lie more at the tactical level than

the strategic level, with their skills limited to an excellent functional understanding of those areas covered by their products.

Exhibit VI-5 covers some of the issues that arise in offering users applications software products as part of a CIM solution.

The majority of vendors considered it very important to be able to put forward appropriate applications software products on their own behalf, although some vendors are content to introduce the appropriate third party as required. IBM has been very active recently in forming ever-closer links with its chosen applications software product vendors.

EXHIBIT VI-5

Issues in Buying Process Computer-Integrated Manufacturing, Europe

Issue \ Vendor Type	Level of Importance		
	Equipment Vendors	Professional Services Vendors	Application Software Product Vendors
Ability to offer appropriate application software products	Medium	High	High
Choice of application software products	Low	Medium	Medium
To be recognised developer or distributor	Low	Medium	High
Impartiality in choice of application software product	Low	Medium	Low

On the whole, vendors do not consider it appropriate to offer users a choice of package. Even where vendors have access to a range of packages from which they can choose, they will normally decide which is most appropriate in the circumstances and present solely this one to the user.

The greatest degree of variation between vendors was in response to the question:

“How important is it when targeting systems integration projects in the discrete manufacturing sector to be viewed as impartial in the choice of applications software product?”

The answer to this question depends very much on the individual marketing strategy of each equipment vendor or professional services vendor. Some equipment vendors and professional services vendors regard it as an important element of their positioning to appear impartial in subcontractor selection in the eyes of their users. Others, particularly many of the equipment vendors, do not position themselves in this way.

Finally, CIM is not a term many vendors would wish to use in front of their clients. Business integration is much more in favour. This partly reflects the importance of integration across the whole enterprise, and even involving clients and suppliers, rather than just within the manufacturing function. CIM implies a concern with technological—rather than business—issues, which vendors are keen to avoid. Finally, the approach to CIM is seen as a more gradual one, integrating areas in response to business needs as they arise. CIM on a grand scale has so far failed to prove that it delivers real business benefits.

C

Nature of CIM Projects

1. Typical Project Types

CIM projects arise from user organisations' needs for greater vertical and horizontal integration to gain access to information and to make it more widely available.

An indication of the importance of each of the main types of vertical integration projects encountered by vendors is shown in Exhibit VI-6. The most common type of project remains the linking of production management systems to the shopfloor. However, at present the main priority is the collection of up-to-date information from the shopfloor, with a much smaller proportion of projects involving the direct control of shopfloor equipment.

The linking of CAD to production management systems via integrating products such as computer-aided process planning (CAPP) and engineering data management (EDM) shows a lower level of activity than shopfloor data capture, though such links are starting to be implemented in the design-intensive sectors such as aerospace and automotive.

Supply chain integration is very important in assisting manufacturers to improve their responsiveness to clients. This requires comprehensive integration between sales order processing, distribution, and production systems so that products can be accurately tracked—and delivery dates forecast—from delivery of the components by the supplier through to finished goods. Access to up-to-date information from the shopfloor is essential if this goal is to be achieved.

EXHIBIT VI-6

Typical Project Types Computer-Integrated Manufacturing, Europe

Project Type	Frequency of Occurrence
Linking production management to shopfloor systems	High
Engineering data management	Medium
Linking CAD/CAE to production management	Medium
Shopfloor equipment control	Low-Medium

Supply chain management increases the emphasis on links with clients and suppliers, and this extends to exchanging design data in addition to commercial information such as orders and order status.

Traditionally, CIM has been regarded as the preserve of large companies. However, in a number of sectors—such as automotive and telecommunications—that are dominated by large organizations, these large companies indirectly put pressure on their much smaller suppliers to move towards CIM because companies such as Ford, for example, expect their suppliers to be capable of:

- Exchanging design data electronically
- Supporting JIT procedures via the use of EDI for orders and invoices
- Developing strong quality assurance and improvement measures such as statistical process control

While it is possible to adopt these measures and be responsive to large clients without CIM, immediate access to information and a high level of integration of systems makes this task easier.

Another major driving force towards greater integration of systems is a need for comprehensive product and component tractability as found, for example, in the aerospace and defence sectors.

2. Shopfloor to Production Management Integration

User motivations for integrating information from the shopfloor with production management systems vary. Typical motivations would include:

- A first step towards CIM
- A prerequisite for implementing total quality management
- A means of supporting JIT and ensuring throughput times are reduced

The collection of real-time shopfloor information provides users with the ability to manage the production process more closely. For example, the causes of production delays and quality problems can be identified and corrected promptly, and any recurring problems addressed.

Vendors report intense activity in this area with manufacturers moving towards more sophisticated supervisory control and data acquisition systems. Users are increasingly adopting direct links to machinery on the shopfloor rather than manual entry of shopfloor data.

An example of one of the more sophisticated products for shopfloor data collection and control is Workstream from Consilium. Workstream aims to provide a window onto the shopfloor by tracking the progress of each lot of products or raw materials as it makes its way through the manufacturing process. This is achieved by specifically tracking, monitoring and controlling:

- Materials
- Equipment
- Personnel
- Work instructions
- Facilities

The product incorporates finite scheduling of production and caters for quality assurance via data collection and real-time statistical process control.

Another innovative product designed to address shopfloor data collection and control is CIMITAR from BAeCAM, which provides the functionality:

- To link MRPII systems to a number of production cells
- To break down factory orders into cell orders
- To route materials and jobs through cells
- To monitor in real-time the status of each production cell

Although applications software products are becoming increasingly important components of CIM, application enablers remain an important approach, particularly for large users. This approach is frequently adopted by the equipment vendors. For example, IBM's Plant Floor Series provides both systems and application enablers to support the development of customised distributed factory floor supervisory and control systems for the monitoring and control of production processes.

3. CAD to Production Management Integration

Exhibit VI-7 indicates the current degree of involvement of each of the major categories of vendor in engineering data management, where it can be seen that the principal players in this market are the equipment vendors.

Of course, engineering data management plays a number of important roles other than providing linkages to production management systems. Perhaps its most important roles are in:

- Version control
- Engineering change control
- Making the current design data readily available to design, test and process engineers, in support of concurrent engineering and design for manufacture principles

Engineering data management ensures that the current bill of materials is passed to the production management system, and the implications of any design modifications on the production process and component purchasing are clearly identified. Accordingly, some users regard the engineering database as the basis for CIM throughout the organization.

However, the market for engineering data management is still relatively undeveloped—the major users to date being the larger aerospace and automotive manufacturers.

EXHIBIT VI-7

Vendor Involvement—Engineering Data Management Computer-Integrated Manufacturing, Europe

Vendor Type	Level of Involvement
Equipment vendors	High
Professional services vendors	Low
Applications software product vendors	Low-Medium

Besides engineering data management, another application that is being used to integrate CAD and production management systems is computer-aided process planning (CAPP). At present, it is more common to find production management systems linked to CAPP than to engineering data management.

Tool management is a related area that is also growing in importance.

D

CIM Architectures

The presence of a coherent CIM architecture is a major selling tool for vendors addressing the discrete manufacturing sector, as indicated in Exhibit VI-8. While users may still be concentrating on adding particular applications to their manufacturing systems, or linking just two components such as production management and shopfloor data collection and control, it remains important to demonstrate that they are proceeding along a path compatible with the long-term integration of each of their applications. Accordingly, it is important for vendors to be able to demonstrate to clients that they can progress towards CIM without the need to replace their existing systems.

IBM has led the way in developing a specific CIM architecture based around its mainframe range. To facilitate the sharing of data between applications, IBM has introduced its CIM Communications and Data Facility (CIM CDF). CIM CDF performs a key role in the IBM CIM Architecture (ICA) by housing the repository for all the shared data used within the CIM environment. Major applications such as COPICS are being adapted for use in conjunction with CIM CDF.

EXHIBIT VI-8

Status of CIM Architectures Discrete Manufacturing Sector, Europe

- Major selling tool
- Importance of data management across applications
- Strong move to open systems
- Technology not quite available

However, IBM is strongly aware of the need to provide frameworks for CIM integration for medium-sized manufacturing companies as well, and in line with increasing emphasis on its intermediate CIM (I-CIM) range in recent months, has announced:

- CIM Series/400, which collects, integrates and manages data from applications such as CAD and production management
- Product Engineering Support/400, which supports engineering change control, workflow and bills of material management
- CAD Integration, which enables CAD data to be extracted as the basis for bills of materials

DEC is using its Network Application Support (NAS) protocol as the basis for its CIM architecture, while many vendors are relying on an open systems approach.

One of the keys to achieving CIM is obviously data access and sharing between differing platforms and applications. This issue has been addressed by the equipment vendors for some time, to some extent driven by the need to comply with Phase II of computer-aided logistics support (CALs), which requires all product data to be captured once at source and used many times throughout the organization.

IBM's response has been Product Manager—an enabling product linking design and production applications. Similarly, IBM is providing enablers—the IBM Plant Floor Series—to link production management systems to the shopfloor.

Digital's approach to sharing data between workgroups and applications is its Network Application Support (NAS) architecture, together with use of products such as Sherpa and Powerframe, while Unisys is introducing Data

Shuttle—an agent for data extraction and transfer between applications software products.

The importance of data management across applications is further emphasized by Cincom's CONTROL: LINK product, which provides a standard interface between the company's production management system and third-party applications. CONTROL: LINK enables updates and information requests to be passed from complementary applications software products to the production management system.

Overall there is a strong move to open systems within the discrete manufacturing sector, though at present, this move is mainly concentrated at the level of shopfloor and ancillary systems because the open systems technology is not quite ready:

- To provide the performance required from production management systems within the major discrete manufacturing companies
- To provide the distributed computing facilities necessary to implement CIM across a number of user sites

Manufacturing Application Protocol (MAP) continues to be seen as an expensive and over-engineered solution, applicable only to the very largest users. In 1990 it was estimated that there were less than 20 MAP users in Europe. One possible successor is the Communication Network for Manufacturing Applications (CNMA) being piloted by Renault, BMW, British Aerospace, Aeritalia and Aerospatiale.

E

Role of Partnerships

The principal reasons why vendors collaborate in the CIM market are outlined in Exhibit VI-9. Firstly, one of the key roles of partnerships is to provide vendors with access to sales leads and key decision makers within user organizations. The management consultancies are seen as particularly desirable partners for this reason, while the major equipment vendors perform a similar role for many professional services and applications software product vendors. For example, CGS has recently purchased a number of management consultancies and sees this approach as increasingly important in targeting the CIM market. Similarly, IBM has formed a joint venture with Coopers & Lybrand in the U.S. specifically to target the CIM market from a consulting perspective. From the stand-point of IBM's Approved Industrial Systems Integrators, the generation of sales leads by IBM is one of the major benefits of this relationship.

Secondly, many vendors perceive the CIM market to be increasingly applications software product led. Certainly vendors need to be able to provide a comprehensive range of applications if they are to demonstrate to

clients a clear path to CIM and are to avoid the expense of large amounts of custom development.

EXHIBIT VI-9

Major Roles of Partnerships Computer-Integrated Manufacturing, Europe

- Access to key decision makers
- Access to necessary building blocks
- Access to skills/resources
- Provision of complete offering

Accordingly, vendors such as the equipment vendors and professional services vendors need access to a wide range of applications software products. Individual vendors are adopting radically different approaches to this issue in line with their own positioning in the market.

One group of vendors, typified by IBM, is selecting a single applications software product for each application/platform and marketing it strongly in conjunction with its developer. In the case of IBM, this frequently involves taking an equity stake—or outright acquisition—in the applications software product vendor.

Another group of vendors, typified by DEC and CGS, is keen to demonstrate a high level of independence from any individual applications software product. Such vendors are positioning themselves as comparatively impartial advisers to their clients. Typically these vendors have relationships with a number of applications software product vendors for each of the major application areas, but their agreements with their partners tend to be nonexclusive and without any sales target commitment, such as would be expected of a traditional distributor.

Access to successful applications software products can be a difficult issue for vendors, particularly as there are signs that branding is becoming an important factor in certain application areas. If this becomes the case, then vendors will need access to the market-leading applications software products if they are to succeed in the CIM market.

In addition to access to applications software products, the equipment vendors need access to specialised development skills.

IBM, in recognition of its lack of implementation and systems development resources, has taken the step of appointing a number of Authorised Industrial Systems Integrators. In the United Kingdom, the companies appointed were:

- AT&T Istel Automotive Systems
- BEC Group
- Bytech Systems
- Campbell Lee Computer Services
- Cotec
- CSI
- Hoskyns Industry
- Evets Computers
- Logica Industry
- SD-Scicon Industry
- Servelec
- Systems Guidance

Each Authorised Industrial Systems Integrator is targeted at a particular market to avoid competition between IBM's partners, with some of the smaller integrators acting as subcontractors to the larger vendors.

IBM provides comprehensive support for its Authorised Industrial Systems Integrators, as shown in Exhibit VI-10.

EXHIBIT VI-10

**Support for Authorised Industrial Systems
Integrators
Discrete Manufacturing Sector, Europe**

- | |
|---|
| <ul style="list-style-type: none">• IBM-generated leads• Equipment discounts• Extensive free training• Free presales support |
|---|

Initially this support includes approximately one month's free training per person and covers:

- IBM's CIM architecture
- IBM's product range
- Sales training
- Analysis of industry requirements and trends

Both sales and technical training is provided to the appropriate personnel.

IBM also provides free use of its demonstration facilities for prospect presentations and presales assistance such as help in assembling proposals.

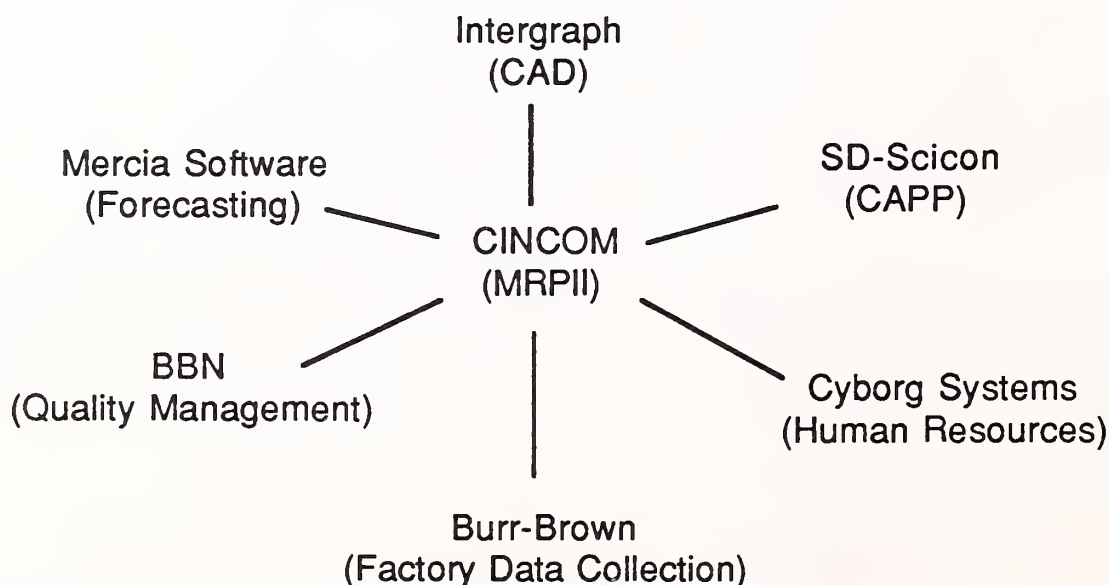
However, one of the main benefits to Authorised Industrial Systems Integrators remains access to leads from IBM.

Cincom identified the need to offer more comprehensive solutions than just production management systems to its clients some time ago, and also recognized the necessity of providing a path that would enable clients to achieve CIM. Accordingly, the company assembled its CIM Alliance programme. The main participants in this programme in the U.K. are shown in Exhibit VI-11.

These partnerships are nonexclusive, but provide prospects with the reassurance that a range of complementary applications software products exist that can be readily integrated with their production management system to assist them in moving towards CIM.

EXHIBIT VI-11

Cincom's CIM Alliance Partners Discrete Manufacturing Sector, Europe



F**Vendor Issues****1. Issues**

The major issues confronting vendors in the CIM market are shown in Exhibit VI-12. Access to user top management is a key issue for all categories of vendor, but particularly for the equipment vendors and professional services vendors. The consultancies, such as Andersen Consulting, are well-positioned here since their business expertise is clearly recognised. However, both the equipment vendors and the professional services vendors recognize the increased importance of high-level business consultancy, and some vendors, such as IBM and CGS, are taking steps to acquire these skills via acquisitions and joint ventures. The equipment vendors are also strengthening their account management to improve their business credibility with major clients and make themselves more competitive with vendors such as Andersen Consulting and EDS.

EXHIBIT VI-12**Vendors Issues
Computer-Integrated Manufacturing, Europe**

- Access to key decision makers
- Data transfer across platforms and applications
- Open systems
- Providing building blocks
- Degree of independence

Another major issue is the means by which integration between applications is to be achieved. Some form of architecture demonstrating the vendor's approach to CIM is necessary to be a credible CIM vendor to users. IBM's ICA is a comprehensive, though complicated, response to this issue. However, even professional services vendors need to demonstrate an approach enabling their clients to move to a fully integrated CIM environment in the future, while retaining most of their existing investment in systems.

All vendors seem to regard the move to open systems as unstoppable. Indeed, some vendors see open systems as a major opportunity to capture

clients from IBM and Digital. However, vendors with offerings based on proprietary architectures are seeing an inevitable downturn in their traditional business areas.

Currently, the best opportunities for UNIX-based systems are on the shopfloor and in ancillary applications. UNIX-based systems are still perceived as lacking the performance to drive large-scale production management systems, while the technology is not yet available to permit the implementation of distributed multisite systems.

If vendors are to appear credible as prime contractors, then they need to be able to assemble a wide range of readily integratable applications.

The degree of independence exhibited by vendors is a positioning issue. Some vendors, such as IBM, will succeed in spite of exhibiting low levels of flexibility in the choice of products offered to users; other vendors will take an opposing stance.

2. Vendor Strengths and Weaknesses

The level of importance of CIM projects to the various categories of vendors is shown in Exhibit VI-13. Clearly, both equipment vendors and professional services vendors regard the market as important and are strongly targeting it.

The strengths of the equipment vendors lie in their:

- Strong account management
- CIM architectures
- Comprehensive product portfolios
- Provision of software enablers for large users

Their weaknesses include:

- Adherence to proprietary architectures
- Lack of true business consulting expertise
- Need to use third parties for implementation and systems development

Accordingly, equipment vendors still frequently take the role of subcontractor in CIM projects, being used for hardware supply and integration, as implied by Exhibit VI-14.

EXHIBIT VI-13

Importance of CIM Projects to Vendors Computer-Integrated Manufacturing, Europe

Vendor Type	Level of Importance
Equipment vendors	Very High
Professional services vendors	High
Applications software product vendors	Medium

EXHIBIT VI-14

Vendor Roles: Prime Contractorship Computer-Integrated Manufacturing, Europe

Vendor Type	Frequency of Undertaking Role
Equipment vendors	Medium
Professional services vendors	High
Applications software product vendors	Low-Medium

However, the equipment vendors play a major role in IS strategy development, as indicated in Exhibit VI-15, and will continue to strengthen their account management to develop this role further.

Many of the professional services vendors are noticeably weaker in account management, particularly in gaining access to user top management. They may be at a disadvantage in the CIM market because of this weakness and their:

- Lack of business consulting expertise
- Lack of formal CIM architecture

Some professional services vendors also appear to lack a coherent, stable applications software product base from which to create a total CIM offering. However, they do have the skills and resources to handle implementation and systems development work well, and in many cases, will rely on supporting these gaps in the capabilities of the equipment vendors.

EXHIBIT VI-15

**Vendor Roles: IS Strategy Development
Computer-Integrated Manufacturing, Europe**

Vendor Type	Frequency of Undertaking Role
Equipment vendors	Very High
Professional services vendors	Medium
Applications software product vendors	Low

VII

Vendor Issues and Strategies

The principal challenges facing software and services vendors targeting the discrete manufacturing sector are shown in Exhibit VII-1. Interviews were largely carried out in 1991.

EXHIBIT VII-1

Principal Vendor Challenges Discrete Manufacturing Sector, Europe

Issue	Number of Vendors
Cross-vendor collaboration	14
Open systems	11
Serving Pan-European clients	7
User downsizing	6

Number of vendors believing factor to be an issue for themselves.

Total sample = 18 software and services vendors.

Multiple answers allowed.

A

Need for Increased Collaboration

As one leading vendor remarked in 1991, "Three years ago, we sold mainly standalone products. Now we are increasingly selling complete business solutions."

This tendency of users to look for a complete business solution, rather than one-off applications, is one of the factors contributing to vendors'

perceptions of an “increasing need for collaboration” with other software and services vendors. There is now clear recognition on the part of vendors that they cannot service the whole range of manufacturing applications themselves, and vendors are looking for specialist partners with complementary products and services.

This trend to increased collaboration is shown in Exhibit VII-2. The exhibit shows the attitude of 16 software and services vendors—all with a significant presence in the discrete manufacturing sector—towards the need for increased collaboration. Eleven companies showed a strong need for increased levels of collaboration.

Another factor is that, particularly in areas like manufacturing resource planning (MRPII), no single package is appropriate to the whole of the discrete manufacturing sector. For example, production processes such as jobbing, discrete batch and assembly line each have differing requirements. There are also specialist sector requirements, such as the defence sector’s need for traceability and contract accounting. Overall, this means that each package is best targeted at specific segments of industry, rather than discrete manufacturing as a whole.

In addition, although a case can be made for professional services vendors’ needing software products to entice prospects, a potential conflict exists between offering both software products and overall project management. The vendor’s ownership of software products may inhibit the project management unit from offering alternative products, and so maximising project management revenues. Similarly, the software products unit may be inhibited from forming alliances with other professional services companies.

Exhibit VII-3 shows the profile of the types of collaboration currently being employed by software and services vendors.

Although some companies are still looking for acquisitions to broaden their applications software portfolios, this approach is no longer as popular as it was a few years ago. Applications software product development is increasingly seen as a specialised and high-risk business, which is best left to the small entrepreneurial company.

The individual project is still frequently the initial driving force behind collaboration between companies. A number of vendors form a consortium to assemble the range of applications software products and services appropriate to a particular prospect. Then, after two or three similar proposals have been put forward, the relationship develops into a more formal one, involving co-ordinated joint targeting of particular sectors.

EXHIBIT VII-2

Need for Increased Collaboration Discrete Manufacturing Sector, Europe

Strong Need	Some Need	Undecided	No Need
<ul style="list-style-type: none"> • We need to broaden our product range • We have strategic relationships with a wide range of third parties • We are not experts in everything • We form alliances with market leaders 	<ul style="list-style-type: none"> • We look to be the agent 	<ul style="list-style-type: none"> • We tend to work on an individual project basis with other companies. This may change in the future. 	<ul style="list-style-type: none"> • We have dominance of this niche sector

Sample Attitude Profile	
Attitude	Number of Vendors
Strong Need	11
Some Need	3
Undecided	1
No Need	1

EXHIBIT VII-3

Evolutionary Stages in Collaboration Discrete Manufacturing Sector, Europe

Stage	Number of Vendors
Links at product development stage	2
Long-term joint bidding	7
Individual project leading to joint marketing	1
Individual project collaboration	3
Acquisitions to broaden product range	1

Type of collaboration currently used by vendors.

Sample of 11 software and services vendors. Multiple answers allowed.

This is the stage that the majority of software and services vendors surveyed have now reached. For example, IBM has appointed a number of Approved Industrial Systems Integrators, while Digital has strategic relationships with a wide range of third parties in the fields of applications software products and professional services/systems integration.

An even more advanced stage of collaboration is where companies work together at the software product development stage. There are clear signs that this collaboration is an increasing trend in servicing the manufacturing sector. For example, Digital and ASK have recently collaborated in developing a manufacturing management system for the process sector, while a professional services company is involved with third parties in developing systems to tackle engineering documentation management.

A summary of the services typically required by applications software product vendors, professional services vendors, systems integration vendors and equipment vendors is shown in Exhibit VII-4. These types of vendor are particularly important in serving the discrete manufacturing sector.

EXHIBIT VII-4

Level of Interest in Service from Partners Discrete Manufacturing Sector, Europe

Services of Interest	Vendor Category		
	Applications Product Vendors	Professional Services and Systems Integration Vendors	Equipment Vendors
Complementary applications packages	High	High	High
Specialised professional services	High	Low	Medium
Overall systems integration	Medium	No interest	Low

The principal services of interest have been separated into complementary application packages, specialised professional services, and overall systems integration. The latter is used to describe the project management of a large project, typically involving the linkage of a number of applications software products. Specialised professional services refers to a more specific task requiring specialist skills, such as shopfloor linkages.

Overall systems integration" is being strongly targeted by the professional services vendors, and so it is not an area they typically wish to subcontract. Overall systems integration is also being increasingly targeted by the major equipment vendors—such as IBM, Digital and Unisys—who wish to be prime contractors for major projects. However, at the present time, these vendors still lack the breadth and depth of knowledge of the discrete manufacturing sector that would enable them to outperform the major professional services companies in this area.

Over the next few years, the major equipment vendors will increasingly continue to become prime contractors themselves, reducing the areas of systems integration subcontracted to very specialist areas where they still lack the necessary skills. For example, IBM's list of Approved Industrial Systems Integrators already shows a bias towards companies with systems integration skills at the shopfloor and factory automation levels, like Evets and the BEC Group.

All categories of vendors are seeking to establish partnerships with leading suppliers of complementary application packages. In particular, the professional services and systems integration vendors seem less intent on either developing or owning applications software products and are

either developing or owning applications software products and are increasingly seeking to offer the most appropriate product for each market segment. This was expressed by one professional services vendor as: "Large companies will become the prime contractors providing the glue in the form of project management. We can give credibility to the package supplier".

However, applications software product vendors are aware of the trend for users to request a complete business solution and are actively forming their own alliances. For example, Cincom stresses its CIM Alliance programme and the ability of its open architecture to provide integration with CAD/CAM, factory data collection, and quality and automated materials handling. Similarly, one of Cincom's major competitors stated that the company had alliance partners for shopfloor data collection, CAD, quality, CAPP, payroll, forecasting and CIM consultancy.

Among vendors serving the European discrete manufacturing sector, there is an increasing divergence into specialist package development companies and integration specialists. Groups of companies are forming consortia to offer complete business systems to users. Accordingly, it is becoming important for vendors operating in the discrete manufacturing sector to have developed partnerships with other vendors that offer complementary products and services. Vendors that do not take this approach may have difficulty in supplying the full range of services required by prospects.

However, the high level of need shown by vendors for complementary software packages presents a significant opportunity to innovative applications software product vendors that should be able to take advantage of the sales efforts of the major professional services vendors and equipment vendors.

B

Open Systems

The perceived importance of UNIX to software and services vendors serving the discrete manufacturing sector is shown in Exhibit VII-5.

EXHIBIT VII-5

Perceived Importance of UNIX Discrete Manufacturing Sector, Europe

Very Important	Some Importance	Not Very Important
<ul style="list-style-type: none"> • We are looking to take market share with UNIX • User acceptance of UNIX is growing every day • UNIX helps in gaining new clients • UNIX systems are coming to the fore 	<ul style="list-style-type: none"> • UNIX is having an impact at plant automation level. Not important at business/environment level. 	<ul style="list-style-type: none"> • UNIX is not an issue within medium/large companies • Smaller companies might buy into UNIX

Sample Attitude Profile	
Attitude	Number of Vendors
Very Important	9
Some Importance	2
Not Very Important	2

Sample of 13 software and service vendors.
The specialist CAD vendors are excluded from the sample.

Overall, there is a strong consensus that UNIX is becoming increasingly important in the discrete manufacturing sector, and that user acceptance of UNIX is growing. UNIX has dominated the CAD market for some years, and so the CAD vendors were not included in this sample.

The areas where vendors felt that UNIX would make the most impact initially were in the smaller companies and at the plant automation level.

UNIX-based systems were felt to be making the least impact with the larger discrete manufacturing companies and at the business/commercial level. The larger companies were thought likely to retain their IBM and Digital purchasing policies for some time yet, and the AS/400 is proving to be a formidable competitor to UNIX at present. Nonetheless, some vendors believe that UNIX-based systems represent their best chance of winning business away from IBM and Digital.

Similarly, in application terms, UNIX is believed to be making least headway in the discrete manufacturing sector in commercial applications, such as production management systems. However, one trend which must be worrisome for IBM and Digital is the speed and consistency with which many of their traditional production management software products vendors are basing the latest generations of their products around UNIX. These moves are particularly prevalent amongst companies that formerly used Digital equipment as their main platform.

C

Users Become Pan-European

As shown by the comments in Exhibit VII-6, another issue raised by vendors, and which was confirmed by INPUT's user research, is that users are becoming more pan-European, or even global, in outlook. This new outlook has probably been prompted by the focus on the single European market across Europe. Indeed, some Swedish and Swiss companies are being more proactive than organisations resident within the European Community as they fear exclusion from its markets from 1993 onwards. As a result, there is considerable refocusing and merger activity as discrete manufacturing companies seek to establish themselves as major European concerns in their chosen sectors.

EXHIBIT VII-6

Pan-European Comments from Vendors

- “Mergers and acquisitions are generating truly pan-European companies.”
- “Companies want a single information system across Europe.”
- “Companies are looking to standardize on manufacturing management systems across plants so that they can compare ‘apples’ with ‘apples’.”
- “They are looking for common systems down to production management level.”
- “Multinationals are increasingly recommending uniform platforms to their operating units.”

One consequence of this activity is that companies are endeavouring to manage their operations on a common basis across Europe and to compare performance across plants in a meaningful way. To achieve this, companies are standardising on the equipment platforms and software products used. In addition to facilitating comparison between plants, such measures make it easier to transfer information—such as design data—or even production between plants.

Other implications of this move to European standardisation include:

- An increased tendency for users to accept standard software
- A need for software to be pan-European in functionality
- A move to distributed systems in the future

Overall, these trends create opportunities for vendors with the infrastructure to support pan-European clients. For those vendors with limited European coverage, it becomes even more imperative to seek international mergers or collaborations. Digital has just restructured in Europe for exactly this purpose: industry sector pan-European focus.

D**User Downsizing**

Another trend, reflected by the vendor comments in Exhibit VII-7, is that as the processing power of computers continues to increase, and as the support

costs for mainframes remain high, users are downsizing systems. This downsizing is likely to accelerate once the level of acceptance of distributed systems increases within the discrete manufacturing community.

EXHIBIT VII-7

Downsizing Comments from Vendors

- “People are no longer putting manufacturing management systems on IBM mainframes.”
- “A noticeable number of companies are downsizing their manufacturing management applications from 370 architecture to AS/400.”
- “One large customer is evaluating how to move from mainframe-based to UNIX-based distributed systems.”
- “PC networking will become an issue (for manufacturing management systems).”

Obviously, this trend is particularly pronounced in the CAD market, where workstations and microcomputers are now the norm. Downsizing is now becoming more pronounced in other areas, such as production management systems, as well.

For example, the number of applications software product vendors that actively target the mainframe-based end of the production management systems market has decreased markedly over the last few years. As the mainframe segment has declined in importance, so these software products vendors have either increasingly emphasized the proprietary minicomputer versions of their products or developed new products to run on AS/400 or under UNIX.

This downsizing extends all the way down the market. Even turnkey suppliers marketing minicomputers to the smaller discrete manufacturing companies are expecting to be affected by an increased demand for microcomputer LAN-based production management systems over the next few years.

E**Vendor Targeting**

Exhibit VII-8 shows the principal opportunities in the discrete manufacturing sector and the extent to which opportunities are being targeted by equipment vendors, professional services vendors and applications software product vendors.

EXHIBIT VII-8

**Vendor Targeting of Growth Areas
Discrete Manufacturing Sector, Europe**

Growth Area	Vendor Category		
	Equipment Vendors	Professional Services Vendors	Applications Software Product Vendors
Systems integration	High	High	No Interest
Systems operations	No Interest	High	No Interest
Software products			
- SFDCC	High	Medium	Medium
- Engineering data management	High	No Interest	Low
- Completion of CIM wheel	Medium	Low	High
- MRPII replacement	Medium	High	High

The systems integration market is strongly targeted by both the major equipment vendors—such as IBM, Unisys, Digital, SNI, Bull and ICL—and the leading professional services vendors—such as CGS, Sligos and the Sema Group. However, at present, the equipment vendors are in the process of building their systems integration capabilities. As a result, even though equipment vendors are using their internal manufacturing experts to good effect, they currently lack both the depth of skills and the industry expertise to dominate the market, and are having to subcontract much of the work to professional services vendors.

Two approaches to the systems integration market are being followed by professional services vendors. Some vendors are taking the view that ownership (or sole distribution rights) of a full portfolio of applications

software products is a prerequisite to compete in the market. Other vendors are taking the view that ownership restricts their flexibility, and that partnerships with key software product vendors are the key to success.

Systems operations is currently targeted by a minority of professional services vendors. However, other professional services vendors anticipate systems operations becoming increasingly important in the discrete manufacturing sector and would like a share of the business. The prospect of the major equipment vendors, particularly IBM, becoming more active in systems operations in Europe poses a strong perceived threat to the vendors currently active in this sector.

Turning to software products, shopfloor data collection and control (SFDCC) is being targeted by all three categories of vendors. An increasing number of applications software product companies are catering for SFDCC, while equipment vendors are providing both software products and enablers. Enablers provide users with the means to tailor their own systems, using a high-level interface. SFDCC is also a very important area for professional services companies, since substantial tailoring of systems is typically required, whether a software product or an enabler is used as the basis for the system.

Engineering data management is one of the areas for development currently favoured by the major equipment vendors. Digital in particular is strongly pushing the virtues of concurrent engineering. Engineering data management is also an important area for the CAD vendors, which see widespread sharing of CAD data as a key driver of workstation sales.

The production management systems market has become largely a replacement market for large and medium-sized discrete manufacturing companies. However, it remains a large market of considerable importance to all categories of vendor. Much of the growth in production management systems is now coming from the process manufacturing sector, such as the food and chemical industries, rather than from the discrete manufacturing sector.

“Completion of CIM wheel” refers to other applications leading to a full computer-integrated manufacturing environment. Examples include computer-aided process planning (CAPP) and finite scheduling. Applications such as statistical process control (SPC) and maintenance are increasingly becoming part of SFDCC.

Exhibit VII-9 shows the importance of the principal integration areas to each category of vendor.

EXHIBIT VII-9

Importance of Area of Integration to Vendors Discrete Manufacturing Sector, Europe

Vendor Category	Area of Integration	
	Shopfloor to Production Management	CAD/CAM to Production Management
Principal equipment vendors	Medium	High
CAD vendors	No Interest	High
Professional services vendors	High	Low
Applications software vendors	Low	No Interest

The equipment vendors are endeavouring to provide frameworks, using their equipment, which encompass all aspects of computer-integrated manufacturing. Accordingly, they are strongly targeting both CAD to production management integration and integration of production management systems with the shopfloor. The primary emphasis of CAD vendors is integrating their products with production engineering departments and production management systems. On the other hand, professional services vendors tend to be more concerned with the links between production management systems and the shopfloor.

The applications software products vendors tend not to be simultaneously involved in both the CAD and production management markets, with the exception of some vendors providing microcomputer-based solutions. However, applications software product vendors are steadily extending the scope of their applications. For example, production management software vendors are extending their offerings to include functionality for shopfloor data collection and distribution areas.

F

Generic Strategies

The major equipment manufacturers are endeavouring to provide frameworks that will enable users to build complete CIM systems. Similarly, the systems integration market is becoming more important to these vendors, as they seek to control their major accounts.

IBM will endeavour to impose its own CIM architecture on users and will, on the whole, provide access to UNIX-based systems rather than adopting UNIX solutions itself. In the move towards providing a complete CIM environment, IBM is stressing its engineering database and its plant floor systems. The shopfloor area is one in which IBM has traditionally had a comparatively low market share, compared to Digital. The company has now introduced the IBM Plant Floor Series to rectify this state of affairs. The Plant Floor Series supports the development of a customised distributed factory floor supervisory system for the monitoring and control of production processes. IBM is continuing to collaborate with software products vendors, to put the company in a position to offer a complete range of applications software products for manufacturing companies. One of IBM's latest moves, and one that complements the Plant Floor Series, is the marketing of the Trimax Maintenance Management System.

IBM is also starting to put more emphasis on its intermediate computer-integrated manufacturing offerings, based around the AS/400 and RS/6000.

The professional services vendors, such as CGS and EDS, are also targeting the systems integration market. Here, there are two major issues for vendors to resolve. Firstly, there is the question of how they should tackle pan-European coverage. Secondly, there is the question of how to meet the complete requirements of discrete manufacturing companies. There are two approaches to this second question. One approach is to try to build up a complete range of products and services in-house, since this clearly demonstrates the vendor's commitment and expertise to clients. While this approach obviously has some appeal, it is both an expensive and an inflexible option. It is also likely to be quite restrictive, in terms of coverage of the various sectors of the discrete manufacturing marketplace.

The other approach is to build an extensive framework of partnerships, in much the same way as equipment vendors such as Digital, and to use whichever partners seem to be appropriate in any individual situation. In this way, a greater perception of impartiality can be built-up with the client though with the risk of appearing less experienced in the applications selected.

Applications software products vendors are finding their strategies dictated by the pressures of downsizing and open systems. While many of the vendors that primarily targeted IBM mainframes are now looking to the AS/400, the vendors that formerly used Digital-based equipment are now moving towards UNIX and database independence. They are also entering into partnerships with professional services vendors and other applications software product vendors.

Applications software product vendors are also extending the scope of their offerings. For example, vendors of production management systems are extending their coverage to include distribution and shopfloor data collection.

VIII

User Issues

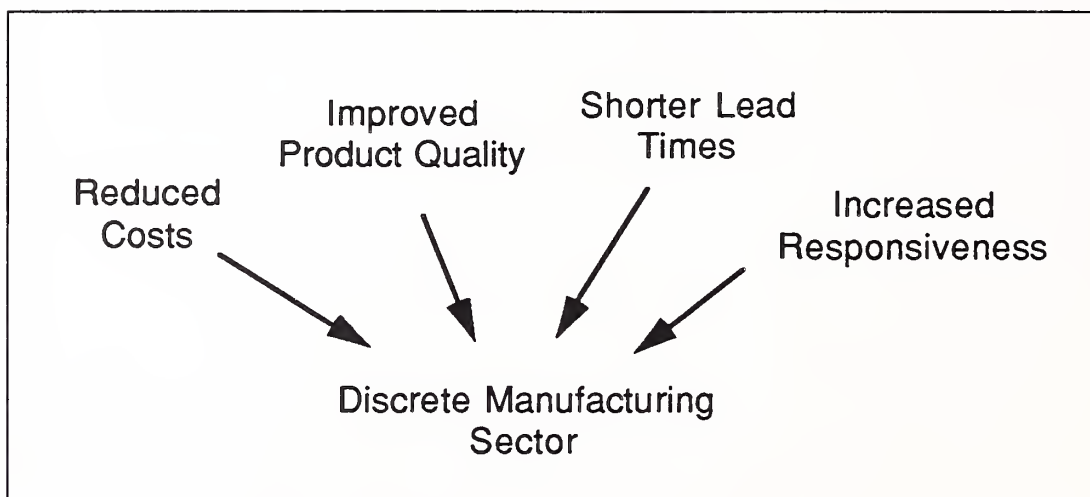
Driven by the need to become major players in the Single European Market, many discrete manufacturing companies are identifying their core businesses and seeking to establish themselves in these on a pan-European basis. Typically, this involves acquiring operations across the major countries of Western Europe. Noncore activities are being divested to allow management to concentrate on developing their companies' key strengths.

One example of this approach is Valeo, a French company that is second only to Bosch in the European automotive components sector. Valeo is seeking to establish itself across Europe as the market leader in clutches, engine cooling, climate control gear and lighting. In support of this strategy, the company acquired Neimann—a large French car component group—and Delanair—a U.K.-based manufacturer of air conditioning systems.

Buying market share and local credibility is, however, only the first step. To remain competitive in the long term, European discrete manufacturing companies typically need to reduce the time taken to introduce new products, improve product quality and reduce manufacturing costs to the levels achieved by the best global competitors, and generally show significantly improved levels of responsiveness to customers. These pressures are summarised in Exhibit VIII-1.

EXHIBIT VIII-1

Pressures on the European Discrete Manufacturing Sector



A recent study of the European car industry, one of the key sectors in the discrete manufacturing sector, concluded that it takes European manufacturers almost double the engineering effort to develop a car, and twice as many hours as the Japanese to assemble a vehicle. Obviously, this has serious repercussions in terms of the sector's ability to compete in terms of new product introduction and on the basis of vehicle price.

The discrete manufacturing sector's response to these problems is increasing adoption of techniques such as concurrent engineering, just-in-time, cellular manufacture and increased levels of automation. The overall philosophy places the emphasis on improving communication between work groups and on simplifying administrative procedures where possible.

Software and services play a key role in assisting companies in the discrete manufacturing sector achieve these goals. Firstly, information systems are important in supporting concurrent engineering at the design stage, ensuring that current design data is readily available, not only to design engineers, but to all other relevant departments, such as production engineering and marketing.

This multidisciplinary approach assists in ensuring that the product is designed with ease of manufacture, unit cost, and reliability taken into account from the start of any design project. Manufacturers are now recognising that product design may be a more important determinant of unit cost than the process technology used in manufacture.

In addition to sharing information within a company, there is a move towards sharing the design process with clients and suppliers. Using another example from the automotive sector, automotive component

manufacturers are starting to take more responsibility for component research and development. They are becoming key members of the vehicle manufacturers' development teams. As such, they need rapid access to the manufacturer's design data.

In return, they are more likely to receive single source, long-term contracts. Delivery lead times and production costs may then be further reduced by use of just-in-time (JIT), which is itself greatly facilitated by use of electronic data interchange (EDI). Increased production flexibility is also required as greater product variability and reduced product life cycles become the norm.

Finally, to manage the production process, discrete manufacturing companies need consistent, up-to-date information on which to act, and the back-office systems need to support actual production in a timely fashion. These goals can only be achieved if a high level of integration is established between each of the major application areas. Hence improved communication of information is required along the value chain from sales-order processing to shopfloor processes and the involvement of suppliers in the manufacturing process.

Some of the major trends arising from these pressures as seen by users are shown in Exhibit VIII-2.

EXHIBIT VIII-2

Major Trends, Users in Discrete Manufacturing Sector

Trend	Probability of Adoption
• Standardised systems across Europe	Very High
• Standardised systems across each factory	Very High
• Increasing reliance on packages	High
• User hardware downsizing	Medium
• Distributed production management systems	Low-Medium
• Widespread use of UNIX	Low

Major trends anticipated by users in European discrete manufacturing sector

As discrete manufacturing companies establish facilities across Europe, they are standardising on the information systems used in each plant. This standardisation further facilitates interplant communication and comparisons by ensuring that data from each plant are in a common format and have been derived in the same manner. Standardisation is typically taking place at least

down to the level of the production management system. This activity is creating opportunities for those software and services vendors in a position to support the users' operations on a multinational basis. For example, one of the users sampled was implementing SAP's production management software in Germany. Once the system proved itself, the user intended to implement the SAP production management system elsewhere in Europe, replacing those systems currently in use.

Although some interest in distributed systems was expressed, it is still too early for companies in the discrete manufacturing sector to have implemented this approach. Systems are still frequently centralised, and one discrete manufacturing company was using a mainframe to run multiple copies—one per factory—of a production management system. At present, users are unsure of the feasibility of distributed systems. However, they are likely to adopt distributed systems for production management, when the technology becomes more established.

Another significant trend is discrete manufacturing companies transferring their production management systems from mainframes to minicomputers. The move to AS/400 systems, in some cases from non-IBM mainframes, is particularly pronounced. The high cost of mainframe systems software, together with the levels of in-house support required for mainframe systems, are important factors in this migration. On the other hand, many companies will continue to use mainframes as the basis for their production management systems for the foreseeable future.

While the majority of software and services vendors believe UNIX to be increasingly important in the discrete manufacturing sector, there is little sign of its being adopted by mainframe users in the short term.

As the cost pressures on discrete manufacturing companies increase, IS departments and the factory floor are affected in a number of ways. Firstly, it is becoming increasingly difficult for IS departments to justify further investments in systems. Secondly, the staffing of some user IS departments is being reduced. These changes are creating opportunities for professional services vendors in the short term. In the longer term, the usage of systems operations by discrete manufacturing companies will rise substantially over the forecast period. One important factor leading to increased usage of systems operations is the move away from mainframe-based systems, which will lead to transition management contracts for systems operations vendors.

Overall, a very high level of intent to integrate existing applications was found amongst users. This applies both to integration between CAD and production management systems, and between production management systems and the shopfloor.

Integration between CAD and production management systems ensures that the appropriate design version is used by all departments. It prevents mismatches arising between bills of materials and assists in engineering change management. Integration between production management systems and the shopfloor leads to effective shopfloor control and prompt feedback on the status of work in progress. Software products vendors are increasingly viewing shopfloor data collection and control as an integral part of their production management systems and they are marketing it accordingly.

IX

Key Opportunities

The principal opportunities for software and services vendors in the discrete manufacturing sector arise out of the need for increasing horizontal and vertical integration within manufacturing companies. These opportunities are listed in Exhibit IX-1.

EXHIBIT IX-1

Areas of Opportunity Discrete Manufacturing Sector, Europe

- Applications software products
- Integration of systems
- Electronic data interchange
- Systems operations
- Partnerships

Firstly, manufacturing companies are establishing operations across Europe and are standardising on the systems used in each of their plants. This provides a major opportunity for those software and services vendors that can support the major manufacturers on a truly pan-European basis.

To enhance their long-term competitiveness, discrete manufacturing companies need to increase the degree of integration between their computer applications. This need is creating opportunities for both professional services and systems integration vendors. Some companies are slowly evolving towards computer-integrated manufacturing, while others are

replacing the bulk of their applications with ones that can be readily integrated.

The use of EDI by discrete manufacturing companies is also expected to grow rapidly over the forecast period. Many major manufacturers have conducted trials of EDI on a limited scale, but there remains considerable scope for the use of EDI to be extended, both in terms of interconnection between companies and in the range of document types exchanged. There is also a strong need within the discrete manufacturing sector to exchange CAD data, as manufacturers and their suppliers move closer to joint development of new products.

Cost pressures also now apply to IS departments, as well as to production managers. This pressure will lead to some reduction in personnel by users over the forecast period, with an accompanying increase in the use of external agencies for both professional services and complete systems operations. The downsizing of many installations from centralised mainframe-based information systems to factory-based minicomputers will also lead to transition management opportunities for systems operations vendors.

This move by users towards more complete business solutions and wider geographical coverage means that it is currently very difficult for any one vendor to service a major client without outside assistance. Hence collaboration between vendors is becoming essential. This collaboration offers considerable opportunities for the smaller vendors to fill the gaps in the service offerings of the major players and so take advantage of their marketing muscle.

For the industry-specific applications software products delivery mode, the major opportunities are listed in Exhibit IX-2.

EXHIBIT IX-2

Applications Software Product Opportunities Discrete Manufacturing Sector, Europe

- Full European coverage, e.g., MRPII
- Engineering data/document management
- Shopfloor data capture and control
- Completion of CIM wheel

Growth in the market for production management systems has slowed appreciably, but the market remains a very significant one. As discrete manufacturing companies standardise on their production management systems throughout Europe, this creates opportunities for the major players. Similarly, as the market moves steadily towards the use of UNIX-based systems, opportunities arise for vendors to establish themselves in this arena. It is by no means certain that the traditional production management system vendors will be the leading vendors in the UNIX-based marketplace.

Engineering data management is obviously an important link between CAD and production management systems and is being heavily promoted by the leading equipment vendors. As yet, user awareness is fairly low but can be expected to increase over the forecast period. Users are already starting to show an awareness of the need to pass bills of materials from their CAD systems to their production management systems, and of the benefits of introducing computer-aided process planning. However, this does not yet seem to have translated into a widespread recognition of the merits of engineering data management.

Shopfloor data capture and control will experience high levels of growth over the forecast period, as discrete manufacturers look to improve their control of the production process and improve their responsiveness to clients.

Obviously, new application areas will become more important as gaps in the vendors' CIM offerings become apparent. Application areas that have recently started to grow include finite scheduling and computer-aided process planning. Just-in-time procedures have also made a major impact on production management systems in recent years.

More detailed growth prospects for some of the principal application areas, broken down by equipment platform, are shown in Exhibit IX-3.

EXHIBIT IX-3

Growth in Discrete Manufacturing Sector Software Products by Application and Hardware Platform

Hardware Platform	Application			
	CAD	Production Management Collection and Control	Shopfloor Data	Production Engineering
Microcomputer	High	Medium	High	High
Minicomputer	Low	Medium	High	High
Mainframe	Low	Low	Low	Low

Within the CAD market, growth will remain high for microcomputer-based products—an area now targeted by IBM, Intergraph, and Prime/Computervision as well as Autodesk.

For production management systems, growth will be low in the mainframe sector, as user downsizing and moves to distributed computing begin to take effect. Growth is currently moderate in the minicomputer and microcomputer segments. The minicomputer segment is now essentially a replacement market, though AS/400-based products are showing comparatively high growth.

Shopfloor data collection and control (SFDCC) is the traditional preserve of the Digital minicomputer. IBM is now targeting SFDCC with the RS/6000 and its industrial microcomputers, and SFDCC is expected to remain a growth area for minicomputer- and microcomputer-based systems.

Growth in production engineering applications is forecast to be largely at the microcomputer end of the market.

The principal issues facing vendors are summarised in Exhibit IX-4.

EXHIBIT IX-4

Vendor Issues Discrete Manufacturing Sector, Europe

- European coverage
- Software products versus professional services
- Partnerships
- Open systems

Vendors targeting the major discrete manufacturing companies in Europe, or vendors that have such companies in their client base, need to recognise the European ambitions of these companies. To ensure their success, vendors need to offer truly pan-European products, and to provide Europe-wide support. In many cases, this will necessitate collaboration between vendors.

There is an increasing divergence between professional services vendors and applications software product vendors. The applications software products business is by its nature a high-risk business, requiring high levels of R&D expenditure. On the other hand, professional services is, on the whole, a people-based, low-risk business—excluding the traumas of some fixed-price contracts. Accordingly, professional services companies need to decide which business they wish to be in.

One approach being taken by some vendors is that software products are a prerequisite to attract business and so product ownership or exclusive distributorships are essential to demonstrate capability and commitment to the market. The disadvantages of this approach are that it limits the vendor's flexibility and perceived level of objectivity. Another approach being taken is that loose partnerships are best since these give the vendor more scope to select the most appropriate products in any given situation. Either way, increased collaboration between vendors is essential in serving the discrete manufacturing sector.

The partnership approach is likely to be increasingly favoured, as vendors are faced with the cost of porting their applications software products to UNIX.

A

Related INPUT Reports

- *European Software and Services Market, 1992-1997—Process Manufacturing Sector*
- *European Software and Services Market, 1992-1997—Distribution Sector*
- *European Software and Services Market, 1992-1997—Banking and Finance Sector*
- *European Software and Services Market, 1992-1997—Insurance Sector*
- *The Western European Market for Computer Software and Services, 1990-1995*
- *Western European Network Services Markets, 1991-1996*
- *Systems Integration Market Forecast—Western Europe, 1991-1996*
- *Systems Operations Market Forecast—Western Europe 1991-1996*
- *U.S. CIM Systems Integration Market, 1991-1996*
- *Industry Sector Markets, 1991-1996—Discrete Manufacturing Sector (U.S.)*

B

Forecast Database by Region

EXHIBIT B-1

Software and Services Market Discrete Manufacturing, Europe

Country	Currency	1991	'91-'92 AGR (%)	1992	'92-'97 CAGR (%)	1997	U.S. \$ Exch. Rate
France	FFM	12,850	12	14,350	11	24,400	5.18
Germany	DMM	4,250	14	4,900	17	10,600	1.52
U.K.	PSM	870	7	935	10	1,520	0.52
Italy	ILB	1,300	13	1,470	15	2,900	1.15
Rest of Europe	U.S.\$M	2,510	12	2,810	14	5,425	1.00
Total Europe	U.S.\$M	10,600	12	11,850	14	22,550	1.00

C Reconciliation

The market sizes and growth rates quoted in this report have fallen significantly compared with those stated in the 1991 report on the discrete manufacturing sector. Changing exchange rates and inflation rate assumptions have produced some significant apparent differences, especially when the forecasts are summarised in dollars.

The worldwide recession has impacted Europe's discrete manufacturing sector, reducing growth rates from 16% to 12% in the short term, rising to a forecast 14% in the longer 1997 period. The U.K., France and Sweden have been among the worst affected and may take several years to recover.

Exchange rate changes lifted the 1991 European market size (measured in U.S. dollars) by 6% to \$10,600. Exhibit C-1 shows the changes between the 1991 report and this 1992 report.

EXHIBIT C-1

Software and Services Market Discrete Manufacturing, Europe

Country	Currency	1991 Report 1991 Forecast	1992 Report 1991 Actual	Variance (%)	1991 Report CAGR Forecast	1992 Report CAGR Forecast
France	FFM	13,140	12,850	-2	16	11
Germany	DMM	4,165	4,300	+3	20	17
U.K.	PSM	900	870	-3	13	10
Italy	ILB	1,290	1,300	<1	15	15
Rest of Europe	\$M	2,490	2,510	<1	15	14
Total Europe	\$M	10,500	10,600	+1	16	14

